EQUILIBRIUM MOISTURE AND DRYING CHARACTERISTICS OF TEXTILE FIBERS

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EQUILIBRIUM MOISTURE AND DRYING

CHARACTERISTICS OF TEXTILE FIBERS

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ACKNOWLEDGMENTS

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EQUILIBRIUM MOISTURE AND DRYING CHARACTERISTICS OF TEXTILE FIBERS

SUMMARY

This study was undertaken to obtain data that would permit the proper choice or design of a dryer for ramie fiber.

Equilibrium moisture data was obtained for decorticated ramie, degummed ramie, degummed opened ramie, and raw cotton at 200° F., 170° F., and 140° F. as a function of the relative humidity. Rate of drying studies were made on decorticated and degummed ramie fibers at 170° F. and 140° F.; runs were made at 35%, 54%, and 75% relative humidity at each temperature and at 500 ft./min., 350 ft./min., and 230 ft./min. air velocities at each humidity. The results are summarized and presented in graphical form in Figures 1-19.

INTRODUCTION

Ramie is a bast fiber produced in the bark of the stalk of the Boehmeria tenacisscina; China grass is from the Boehmeria nivea, but the distinction between the two has never been regarded in the economic literature (1). Ramie is commonly used to designate all "Boehmeria" fiber; and China grass is a synonym or the trade name of the Chinese fiber as imported.

The plant is found in India, China, Haiti, Japan, Southern Europe, and the southern part of the United States. The plants grow five to eight feet high and are cut when mature (2). The stalk is usually decorticated while green. This process has been one of the major obstacles in the successful treatment of the fiber. In the Orient the decortication is carried out by hand, but the limited productivity of this method restricts it to area where labor is both cheap and plentiful. Experimenters in the United States have recently developed a machine which is reported to perform the operation satisfactorily (3).

The presence of chemical gums causes the decorticated fiber to become stiff when dry. These gums, which are principally cutose, vasculose, and pectose, must be completely removed before the fiber can be used as a textile. The first two can be dissolved with soap and caustic alkalies under pressure, after which the pectose can be removed by washing (2).

The literature reveals no data that will permit design calculations of dryers for ramie fibers. The need for such data is becoming of increasing importance as a result of the success obtained by research in other phases of the process.

It is the purpose of this study to obtain data that will be useful in the selection and design of drying equipment.

OBJECT

One part of this investigation was to determine the equilibrium moisture content of decorticated ramie, degummed ramie, degummed opened ramie, and cotton fibers. This equilibrium moisture content was determined at 140° F., 170° F., and 200° F. as a function of the percent relative humidity of the enclosing atmosphere.

The other part of this study was to determine the drying characteristics of the decorticated and degummed ramie. These characteristics were determined at 140° F. and 170° F. The study was made for 35%, 54% and 75% relative humidities at each temperature and three air velocities (230 ft./min., 350 ft./min., and 500 ft./min.) at each humidity.

EXPERIMENTAL EQUIPMENT

The basic piece of experimental equipment was a "Proctor" laboratory dryer. This dryer is of a compartment-tray design heated by a Trane steam heater. The necessary humidification is supplied by an open steam humidifier and an air water spray. Baffling arrangements permit three methods of air circulation and variable recirculation.

The temperature and relative humidity in the dryer are regulated by a Foxboro wet and dry bulb humidity controller of the porous sleeve type. The controller is air-operated employing dual controls; one control system governs the dry bulb temperature; and the other, the wet bulb temperature.

Air is circulated through the dryer by a #3LLD Buffalo Fan driven by a one and a half horsepower Diehl motor connected through a variable speed drive. The arrangement permits fan speeds of 274 to 1096 rpm.

Mounted on top of the dryer is a Toledo scale equipped with a hook which is suspended in the drying compartment. The scale is furnished with one ten pound blank beam, two ten pound beams with one ounce gradations, and a five pound chart with one one hundredth of a pound calibrations. This arrangement permits the use of one beam to balance the tare weight while the other beams and the chart are used to measure the sample weights directly.

A tray 20.5 x 20.5 x 3 inches constructed out of one quarter inch galvanized screen was used as the drying tray. The edges of the pan were covered by sheet metal to eliminate end effects; and the air was forced vertically upward through the tray. The tray was suspended by sash chains from the scale hook in the drying compartment.

Other equipment used in the work included an analytical balance, open air electric furnaces, and the usual laboratory equipment.

EXPERIMENTAL PROCEDURE

The fibers used in the investigations were processed as described in the appendix. To insure uniformity of the samples all studies on each type of fiber were made on specimens from the same processing.

The experimental work necessary to obtain equilibrium moisture data was performed first. For every run four samples of each type of fiber were prepared by securing them with a short piece of stainless chrome wire. Two of these samples were placed in an open-air electric oven and dried at least six hours at 230° F. to bring the moisture content below the equilibrium value for the conditions of the run. The other two samples were placed in tap water and allowed to stand at least six hours to completely saturate the fiber.

The Proctor-Schwartz Dryer was used as a constant atmosphere bath. The temperature and relative humidity for the run were established with complete recirculation of the air at a low air velocity. The four samples were then suspended in the air stream and allowed to remain at least twenty-four hours. Test runs proved twenty-four hours to be sufficient time to insure equilibrium between the samples and the air.

After twenty-four hours the samples were moved quickly to numbered 250 ml. Erlenmeyer flasks, which were then tightly closed with rubber stoppers. The flasks containing the samples were weighed on an analytical balance. The samples were then removed from the flasks and placed in the open-air electric oven. The samples were dried over night at 230° F. which brought them to a bone dry or zero moisture content condition. Tests proved that after drying overnight the sample had reached a constant weight.

Next, each sample was replaced in its original flask and reweighed on the analytical balance. The sample was then discarded and the flask, stopper and wire that bound the sample were weighed to determine the tare weight. These three weights give sufficient information to permit the calculation of the moisture content.

The rate of drying studies were made last. The fibers for a run were placed in a water bath and kept submerged from three to four hours. They were then transferred manually to the drying basket and allowed to drain until all loose moisture was lost. The fibers were placed evenly in the basket to a depth of approximately one inch.

The controls of the dryer were set to give the desired value of temperature, relative humidity, and air velocity. The dryer was allowed to run until the chosen conditions were reached on automatic control. With the drying conditions in the dryer thus equilibrated the fan was stopped long enough to allow the basket containing the fibers to be suspended in the drying compartment. The fan was then started again and in a few minutes the "steady state" which had been destroyed by opening the dryer was reached again.

With the drying conditions thus established, the fan was stopped momentarily and the weight of the wet fiber recorded. The procedure was repeated at recorded time intervals until the fiber and moisture in the basket reached a constant weight. These data were sufficient for the calculation of the instantaneous drying rate and with the equilibrium moisture data permitted the calculation of the free moisture content.

The air velocity in the dryer was measured with a velometer. Since the velocity varied across the face of the basket the value given is a mean. The mean is the sum of the velocity-area product of four sections of the basket divided by the total area of the basket. The basket was considered four sections and the velocity at each section was measured.

The portion of cellulose that is insoluble in a 17.5% concentration of sodium hydroxide at 20° C. is known as alpha cellulose. Determination of the alpha cellulose content is a convenient method of assessing the purity of a sample. Representative samples of the four types of fiber were analyzed according to the method outlined by Ott (4).

A moisture analysis was made on several specimens of fiber from drying samples after they had reached a constant weight. This served as a check on how close the drying sample had approached equilibrium.

THEORETICAL CONSIDERATIONS

Drying is the term generally used to indicate the removal of relatively small amounts of water from solid or nearly solid material. In most cases drying involves the removal of water at temperatures below its boiling point and is accomplished by circulating air or some other gas to carry away the water vapor (5).

Dryer design involves two separate yet dependent considerations. First, the moisture must be brought to the surface of the stock to be dried and at this point evaporated. Second, the drying medium must be brought into contact with the stock under proper conditions. The first consideration is more commonly associated with drying theory; and the second, while a function of the first, involves largely the principles of fluid and heat transfer. It is the former that is to be reviewed here.

It is a well established fact that when any material is exposed to a constant atmosphere there will be an interchange of moisture between the two until a final value is reached which is unchanged by further exposure. This condition represents equilibrium between the material and the atmosphere; and the moisture present is known as the equilibrium moisture. This equilibrium moisture is dependent upon the temperature and relative humidity of the ambient atmosphere. Experiments have shown that in some cases it is also dependent upon the history of the material. The importance of equilibrium moisture to drying considerations can be seen since it represents the degree to which a substance can be dried in a given atmosphere.

By analogy with other physical phenomena it is logical that the rate of approach to equilibrium conditions would be a function of the displacement from equilibrium. This leads to the distinction of the free moisture content or the total moisture present minus the equilibrium moisture. This free moisture is the amount of water that can ultimately be removed by the given drying conditions.

If, when the material to be dried is first exposed to the drying atmosphere, the surface is completely wet with water, the drying process is similar to the evaporation of water from a free liquid surface (5). As long as the surface remains wholly wet, the rate of evaporation is not a function of the water content of the stock; and under constant drying conditions the rate of drying is constant. This period is called the "constant rate" period. After reaching a certain moisture content the rate of drying begins to decrease; and the so-called "falling rate" period has begun. The moisture content at which the change from a constant to a falling rate occurs is known as the critical moisture content.

Experimental evidence indicates that during the "constant rate" period liquid moisture is diffusing to the surface of the solid at a rate equal to that of the evaporation from the surface (5). If the drying occurs adiabatically, the equilibrium temperature reached by the solid approaches the wet bulb temperature of the drying air. When heat is supplied directly to the stock by conduction from adjoining dry surfaces of the solid or by radiation from the surroundings, then the surface temperature is higher than the wet bulb temperature, and the rate of drying is increased. An initial adjustment period usually exists during which the wet material comes to the equilibrium temperature which is to prevail in the constant rate period.

During the constant rate period the rate of drying as pounds per hour from a wet surface of A square feet, may be expressed approximately by the equation (6)

$$\frac{dW}{d\theta} = KA(H_s - H_a)$$

where H_a is the absolute humidity of the air, H_s is the saturated humidity at the temperature of the surface of the stock (both expressed as pounds of water per pound of bone-dry air) and K is a constant. The constant K is a function of the air velocity, angle of incidence of the air to the solid, and other variables that affect the film resistance to heat and mass transfer.

The nature of the drying mechanism during the falling rate period is not as definite as for the constant rate period. In general the process is divisible into two secondary periods, which from the mechanisms of drying prevailing in each may be called the "zone of unsaturated surface drying" and the "zone where internal liquid diffusion controls" (6).

The former period follows immediately after the critical point; the decrease in the rate of drying in this zone is due to the decrease in the wetted surface of the material. The mechanism of the drying is essentially the same as for the constant rate period; but dry portions of the solid protrude into the air film, so that the rate of evaporation per unit of total surface is reduced.

The maximum rate of diffusion of water to the surface decreases with the water content of the material (7), so that a second critical point is reached beyond which the resistance to internal liquid diffusion is greater than the surface resistance to vapor removal. During this period the rate of internal liquid diffusion controls the rate of drying. Also during this period air velocity has no influence on the rate of drying; and air humidity is of importance only so far as it affects the equilibrium water content.

For the entire falling rate period the drying rate can be expressed

$$\frac{dW}{Ad\Theta} = f\ (F)$$

where F is the free moisture content. The function the drying rate is of the free moisture content is different for each material and drying condition and must be determined experimentally.

PRESENTATION AND DISCUSSION OF RESULTS

The equilibrium moisture data for the fibers is given in Figures 1-4. The data is presented in the conventional form of per cent equilibrium moisture on a dry basis as a function of the relative humidity. The general shape of the curves is similar to those found in the literature for other textiles. The decorticated and degummed ramie fibers exhibit a hysteresis effect; the effect being more pronounced at low temperatures and high humidities.

The study showed that the equilibrium moisture content of the decorticated ramie is much higher (usually 60% or more) than that of the degummed ramie. This would be expected due to the presence of the water soluble materials in the raw fiber. The dense, unopened, degummed fibers have a higher value of equilibrium moisture than the opened ramie. The undegummed cotton has a slightly higher value of equilibrium moisture than the opened, degummed ramie.

The drying characteristics of the decorticated and degummed ramie fibers are given is Figures 5-19. Figures 5-16 give the rate of drying of the two types of fibers in various atmospheres as a function of the free moisture content. Figures 17-19 show the effect of air velocity on the drying rate at a fixed temperature and relative humidity.

An examination of the drying curves shows the typical "falling-rate" and "constant rate" periods. The decorticated fiber has a critical moisture content that ranges from 115-125% total moisture and the degummed fiber has a critical moisture content in the limits of 75-85%. Figures 17-19 illustrate that internal diffusion is not a controlling factor in drying either the decorticated or degummed fibers as the air velocity affects the drying rate throughout the "falling-rate" period.

The data presented by no means covers all the possible drying conditions. Proper utilzation of it will, however, permit one to make an economical choice or design of a dryer for ramie fibers.

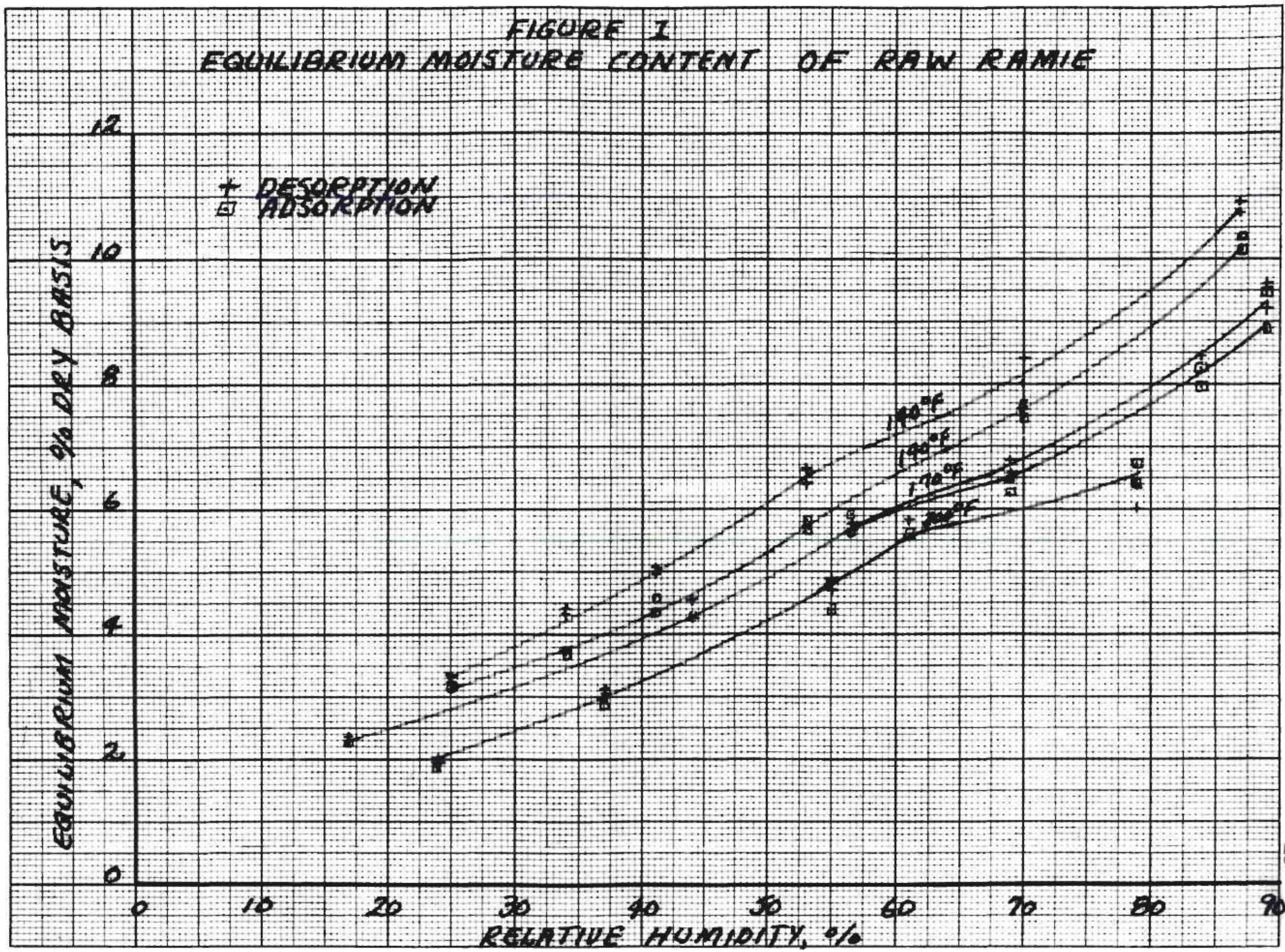
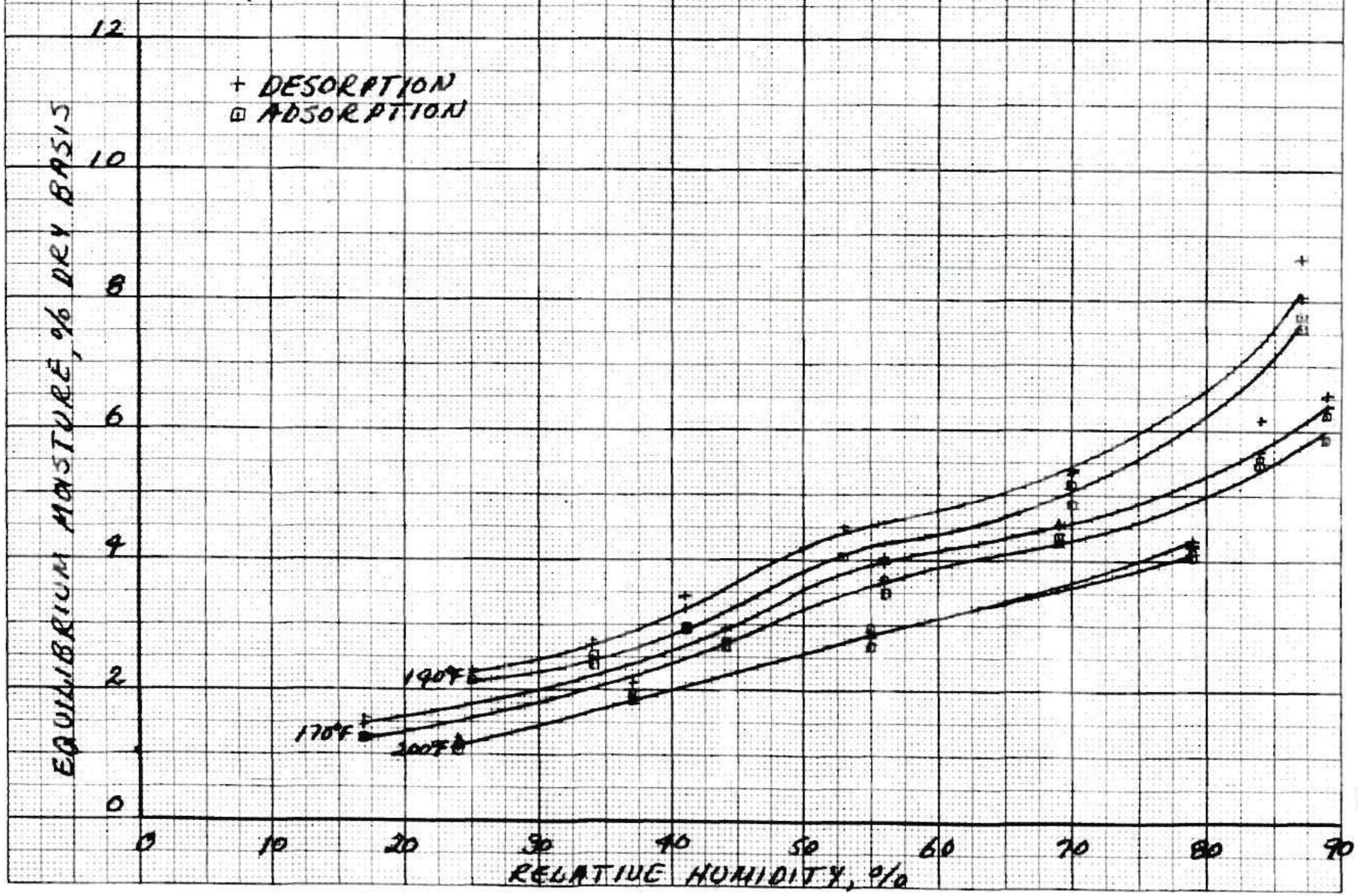


FIGURE I
EQUILIBRIUM MOISTURE CONTENT OF RAW RAMIE
+ DESORPTION
□ ADSORPTION
EQUILIBRIUM MOISTURE, % DRY BASIS
RELATIVE HUMIDITY, %
0
2
4
6
8
10
12
0
10
20
30
40
50
60
70
80
90
170°F

FIGURE 2
EQUILIBRIUM MOISTURE CONTENT OF DEGUMMED RAMIE



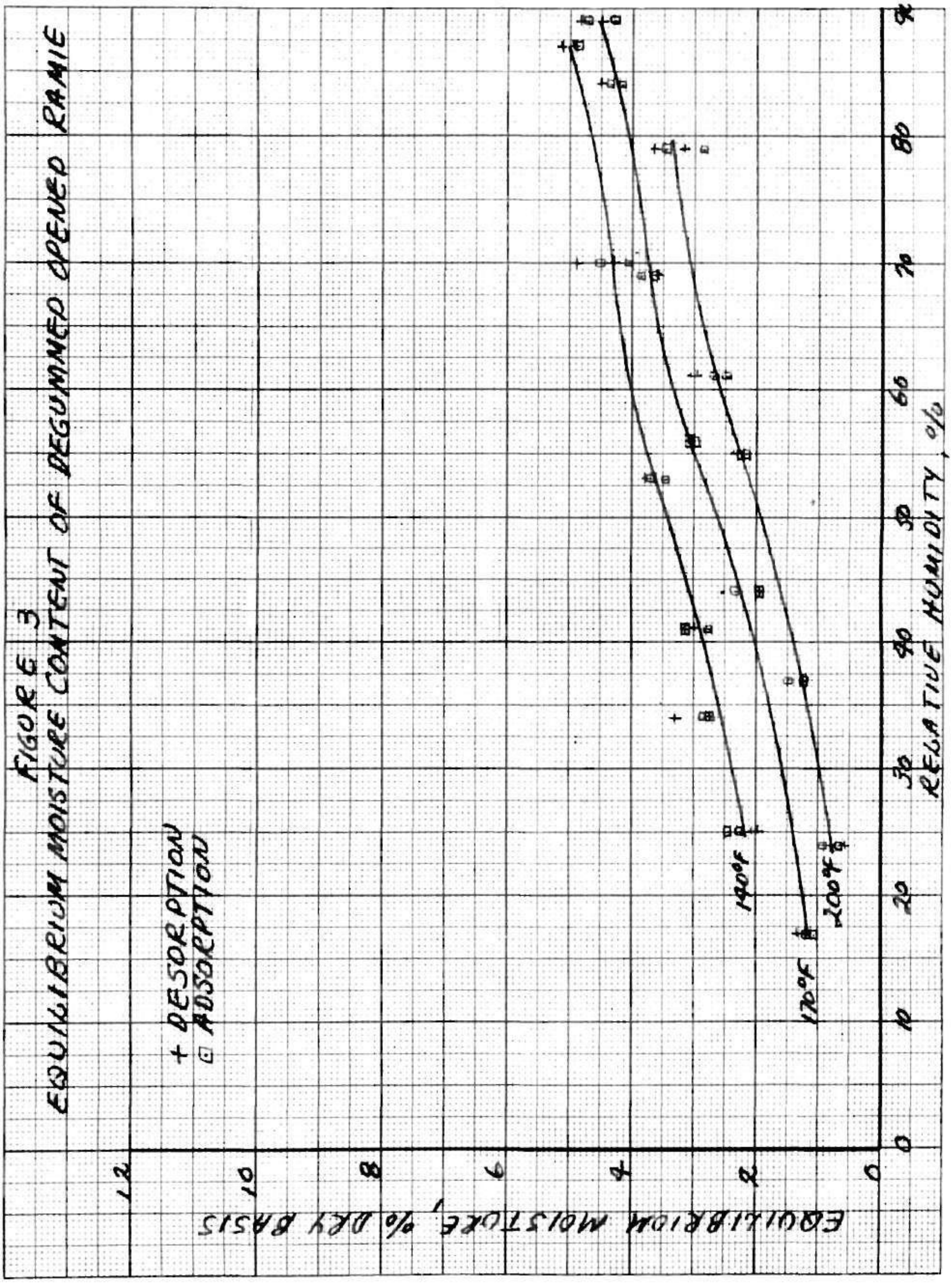


FIGURE 3
EQUILIBRIUM MOISTURE CONTENT OF DEGUMMED OPENED RAMIE

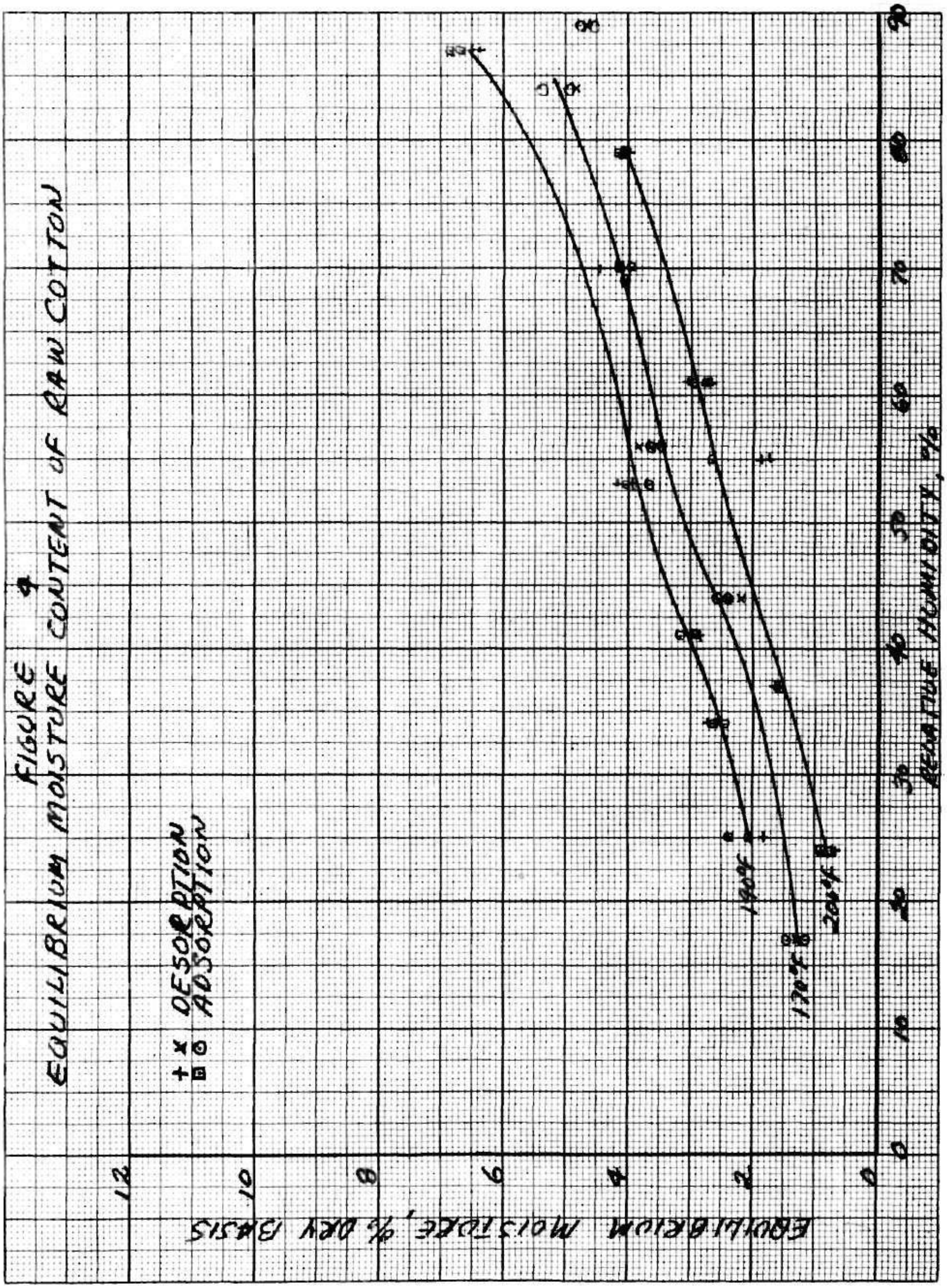


FIGURE 4
EQUILIBRIUM MOISTURE CONTENT OF RAW COTTON
+ x DESORPTION
□ ⊙ ADSORPTION
190°F
170°F
200°F
RELATIVE HUMIDITY, %
EQUILIBRIUM MOISTURE, % DRY BASIS
0
2
4
6
8
10
12
10
20
30
40
50
60
70
80
90

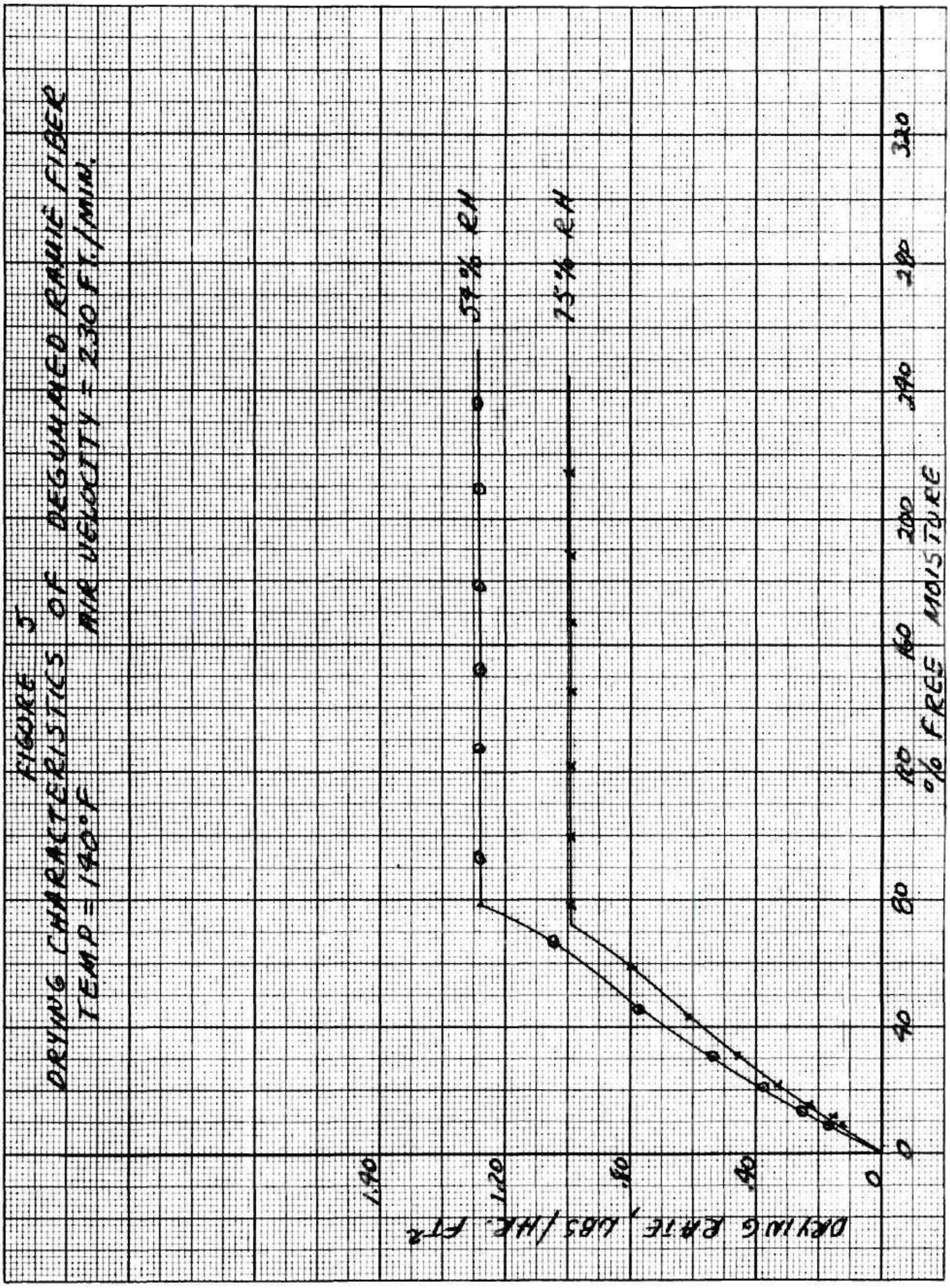


FIGURE 5
DRYING CHARACTERISTICS OF DEGUMMED RAMIE FIBER
TEMP = 140°F
AIR VELOCITY = 230 FT./MIN.
57% RH
75% RH
0
40
80
120
160
200
240
280
320
% FREE MOISTURE
0
.40
.80
1.20
1.60
DRYING RATE, LBS/HR. FT2

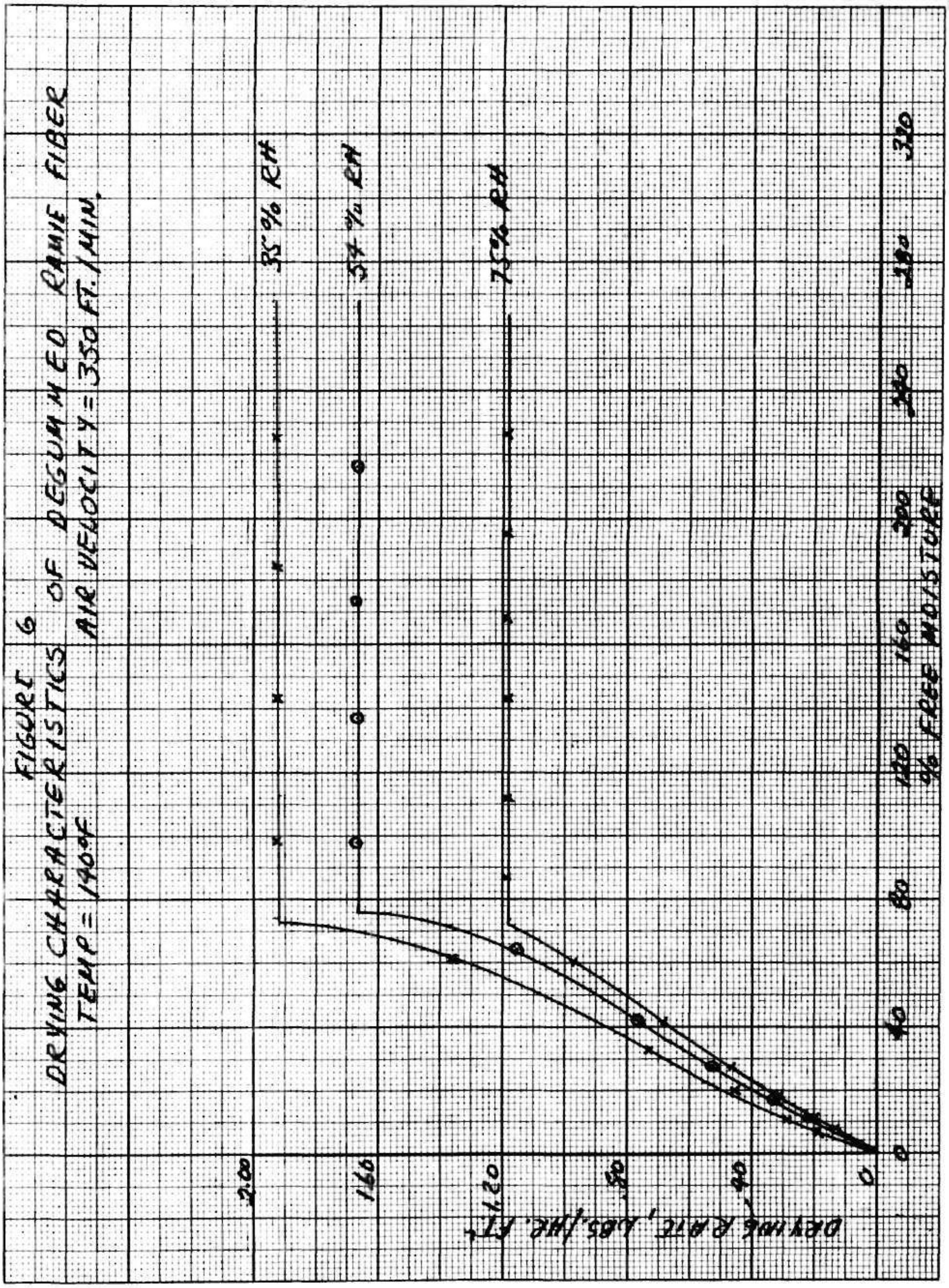
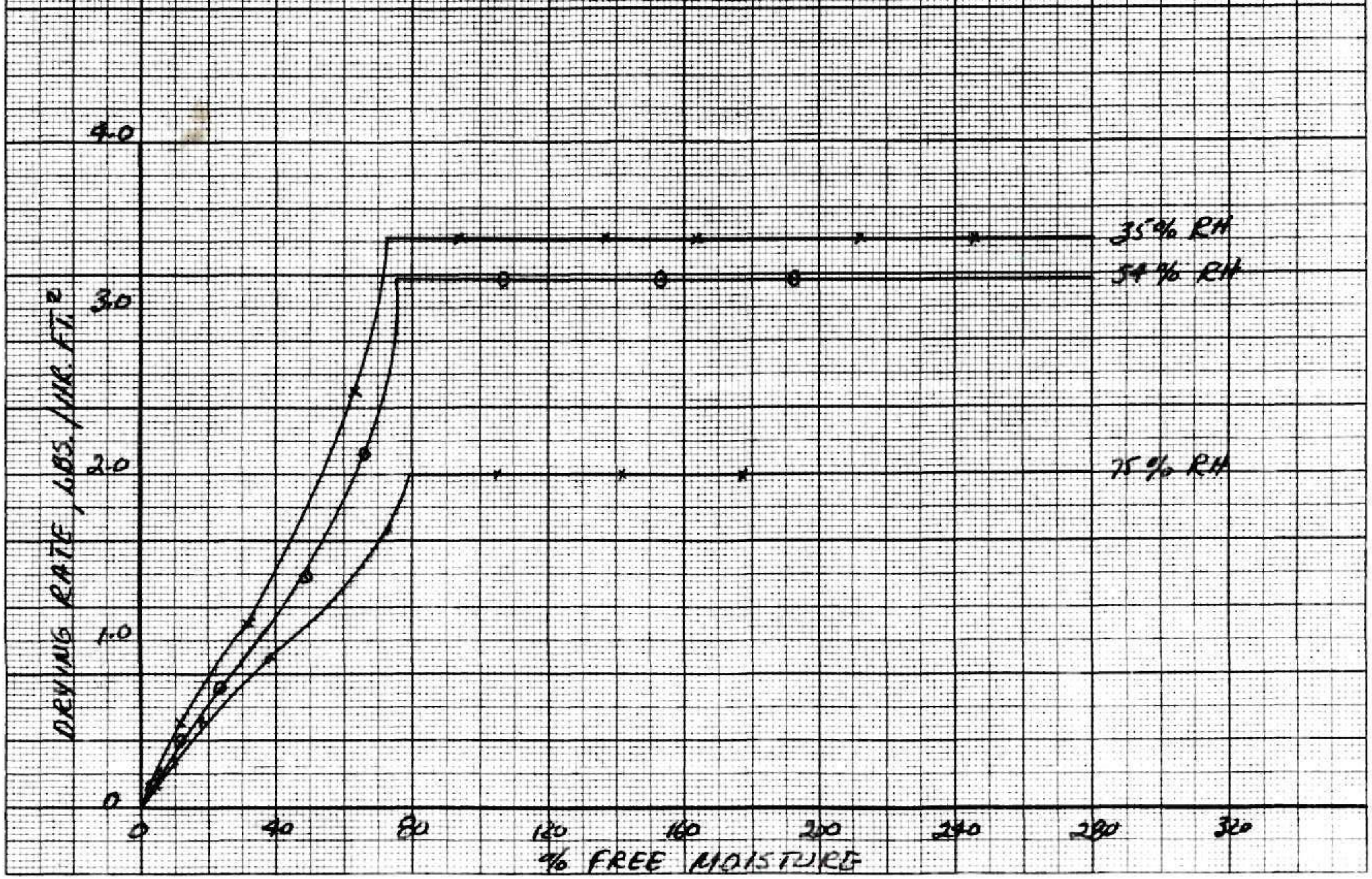


FIGURE 6
DRYING CHARACTERISTICS OF DEGUMMED RAMIE FIBER
TEMP = 140°F
AIR VELOCITY = 350 FT./MIN.
35% RH
57% RH
75% RH
DRYING RATE, LBS./HR. FT.²
% FREE MOISTURE
0
40
80
120
160
200
240
280
320
0
.40
.80
1.20
1.60
2.00

FIGURE 7

DRYING CHARACTERISTICS OF DEGUMMED RAMIE FIBER

TEMP. = 190°F AIR VELOCITY = 500 FT./MIN.



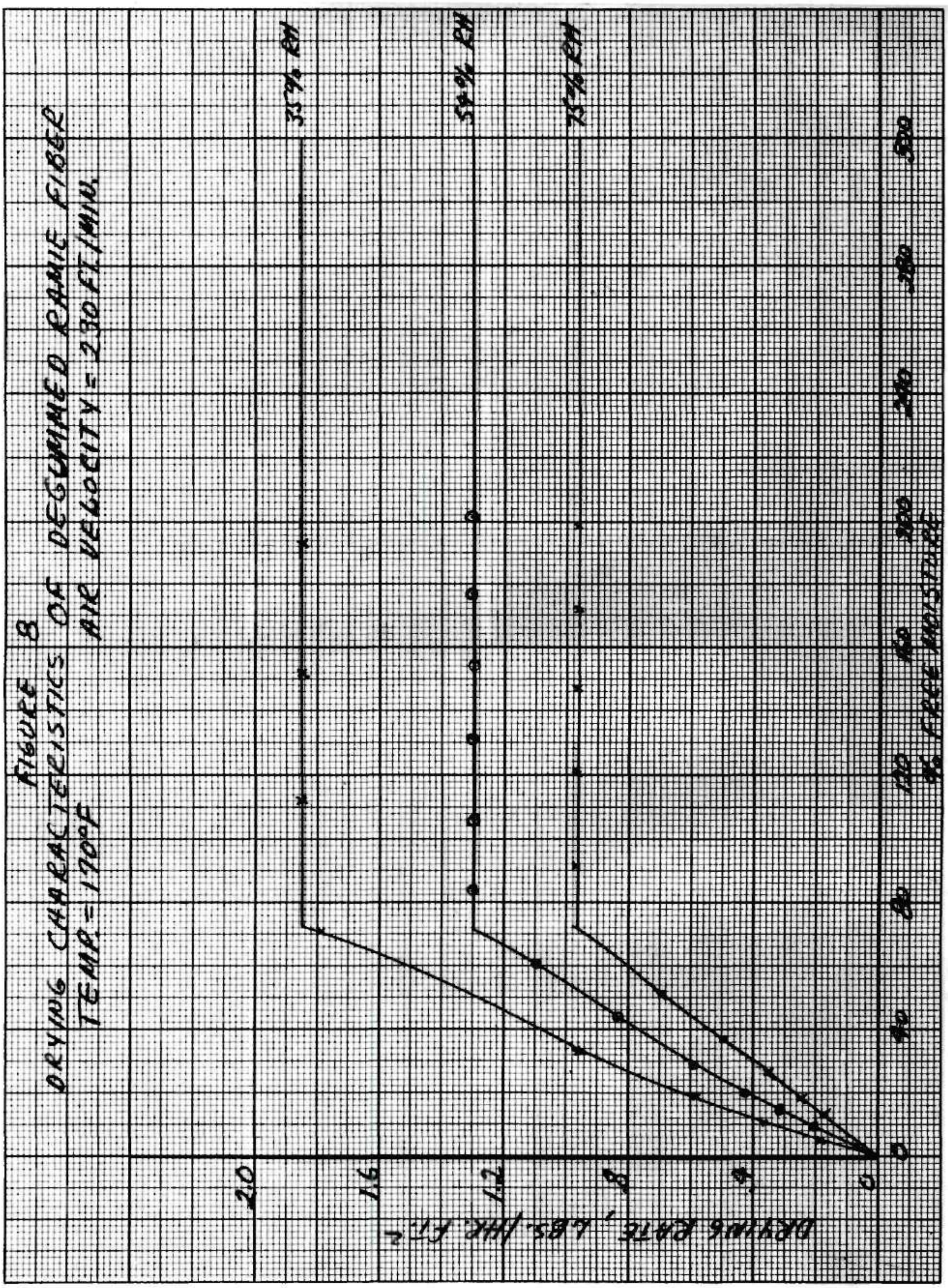
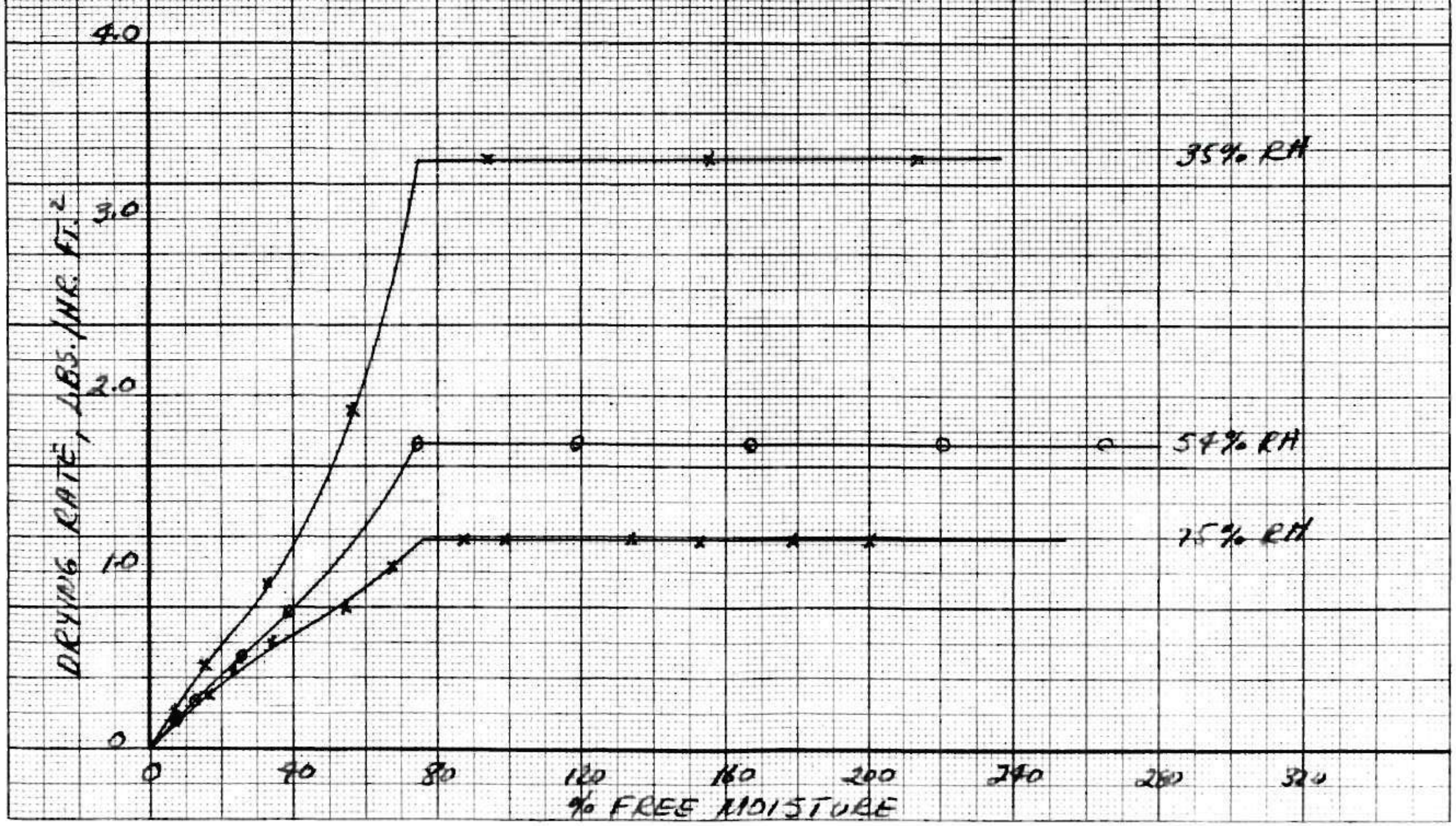


FIGURE 8
DRYING CHARACTERISTICS OF DEGUMMED RAMIE FIBER
TEMP.=170°F
AIR VELOCITY = 230 FT/MIN.
35% RH
54% RH
75% RH
DRYING RATE, LBS./HR. FT.²
0
.4
.8
1.2
1.6
2.0
% FREE MOISTURE
0
40
80
120
160
200
240
280
320

FIGURE 9

DRYING CHARACTERISTICS OF DEGUMMED RAMIE FIBER

TEMP = 170°F AIR VELOCITY = 350 FT./MIN.



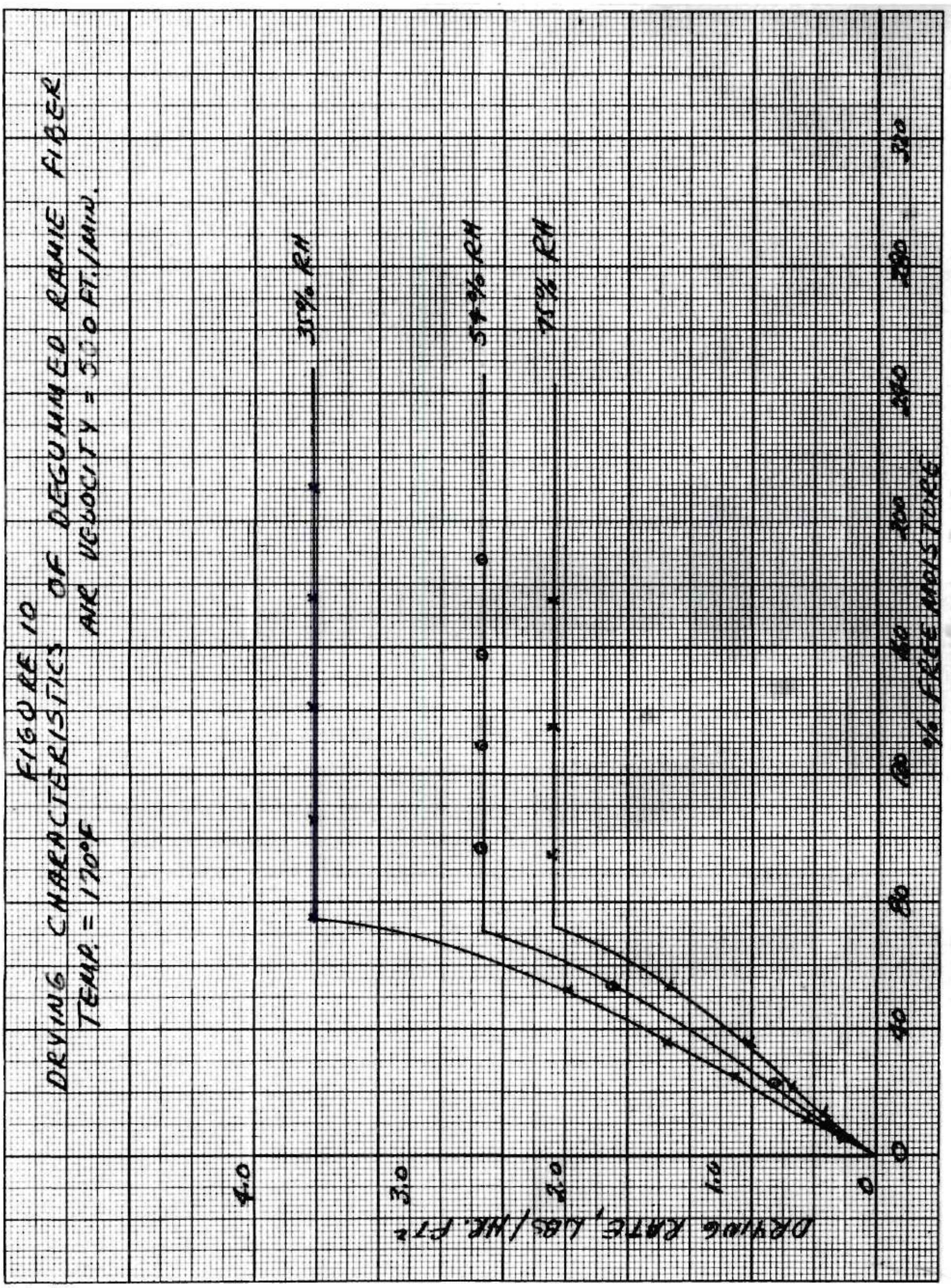


FIGURE 10
DRYING CHARACTERISTICS OF DEGUMMED RAMIE FIBER
TEMP. = 120°F AIR VELOCITY = 500 FT./MIN.

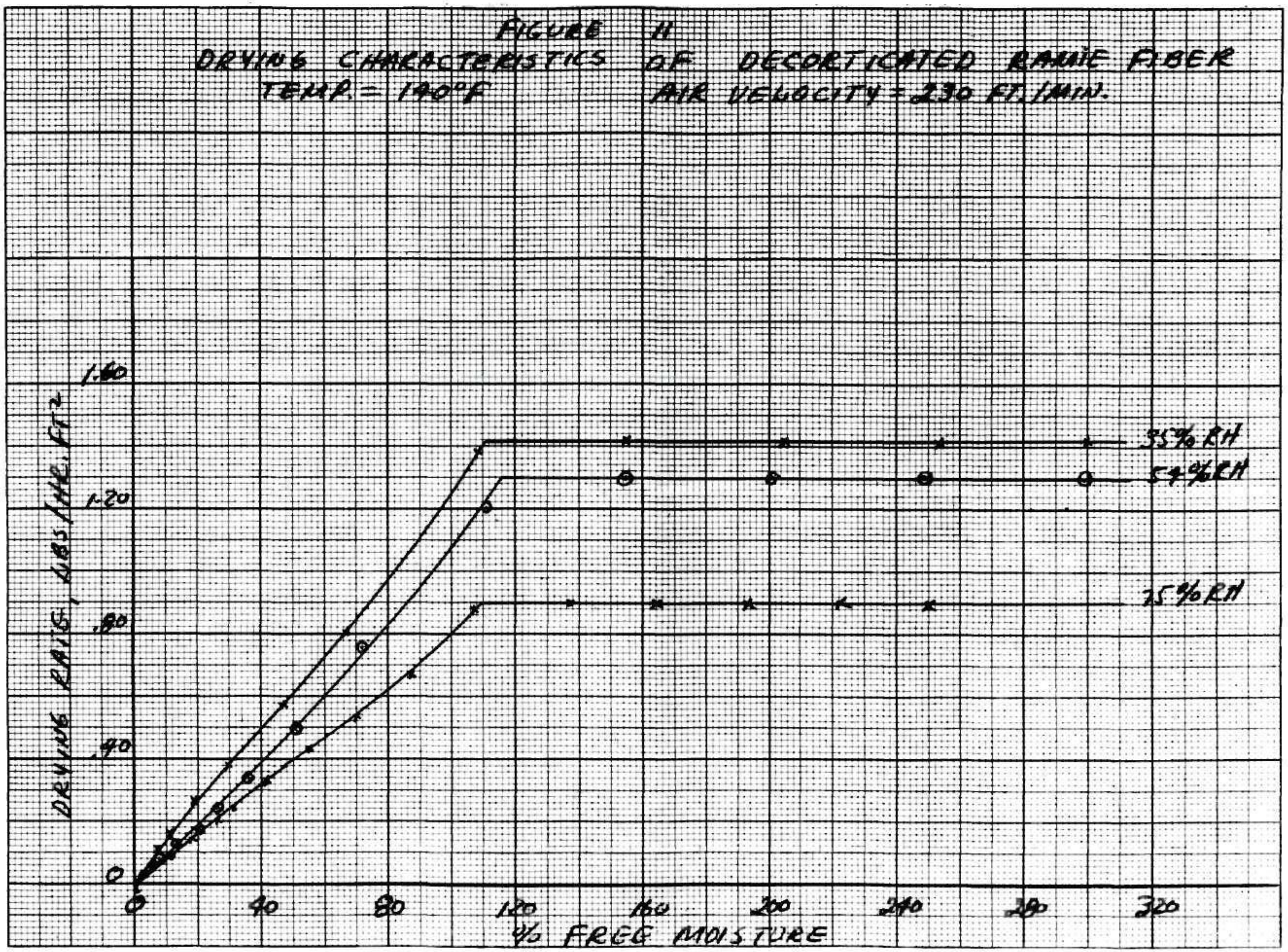


FIGURE 11
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER
TEMP. = 140°F
AIR VELOCITY = 230 FT./MIN.
35% RH
54% RH
75% RH
DRYING RATE, LBS./HR. FT²
0
.40
.80
1.20
1.60
0
40
80
120
160
200
240
280
320
% FREE MOISTURE

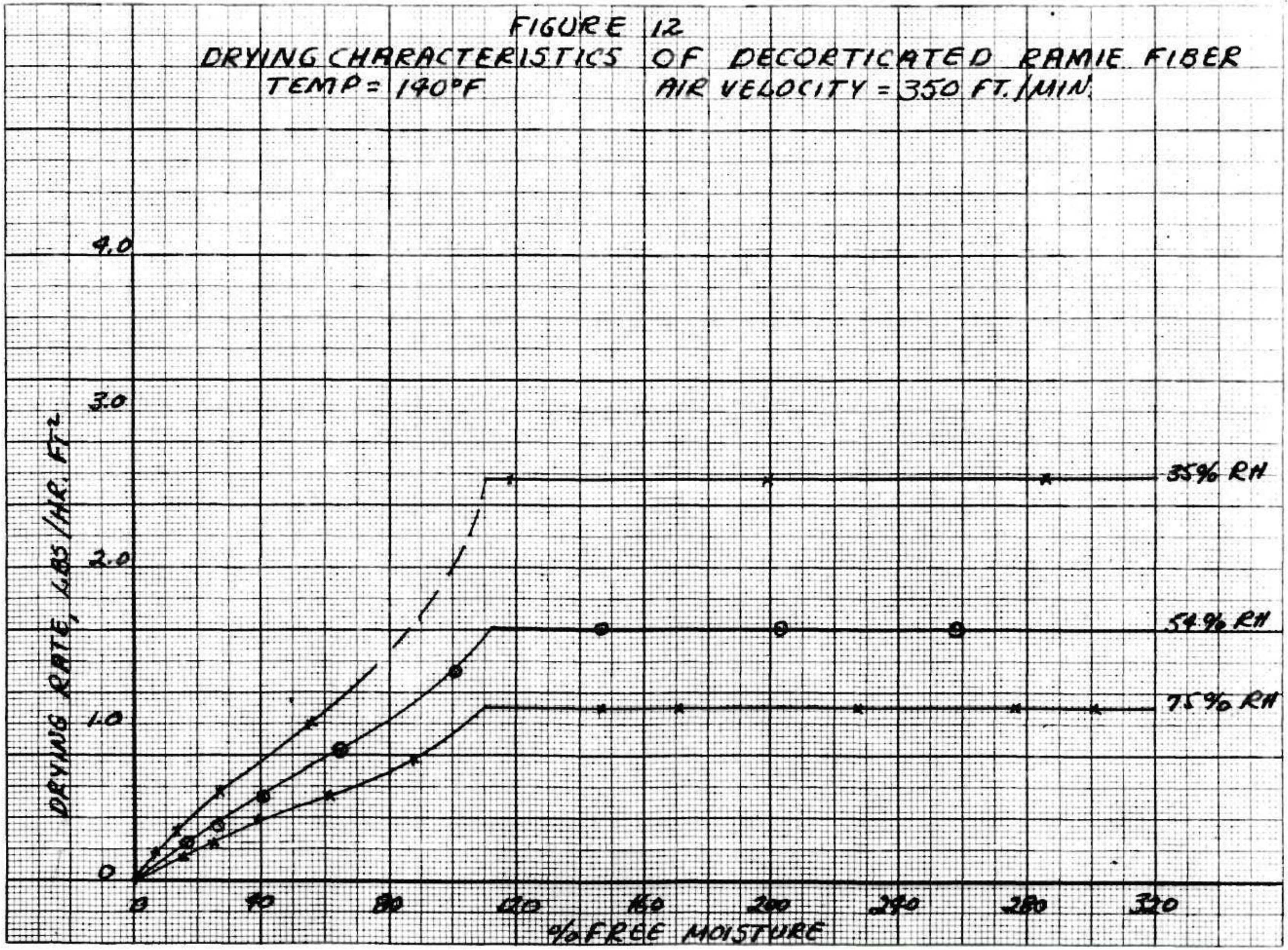


FIGURE 12
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER
TEMP = 140°F
AIR VELOCITY = 350 FT./MIN.
DRYING RATE, LBS/HR. FT²
% FREE MOISTURE
0
1.0
2.0
3.0
4.0
40
80
120
160
200
240
280
320
35% RH
54% RH
75% RH

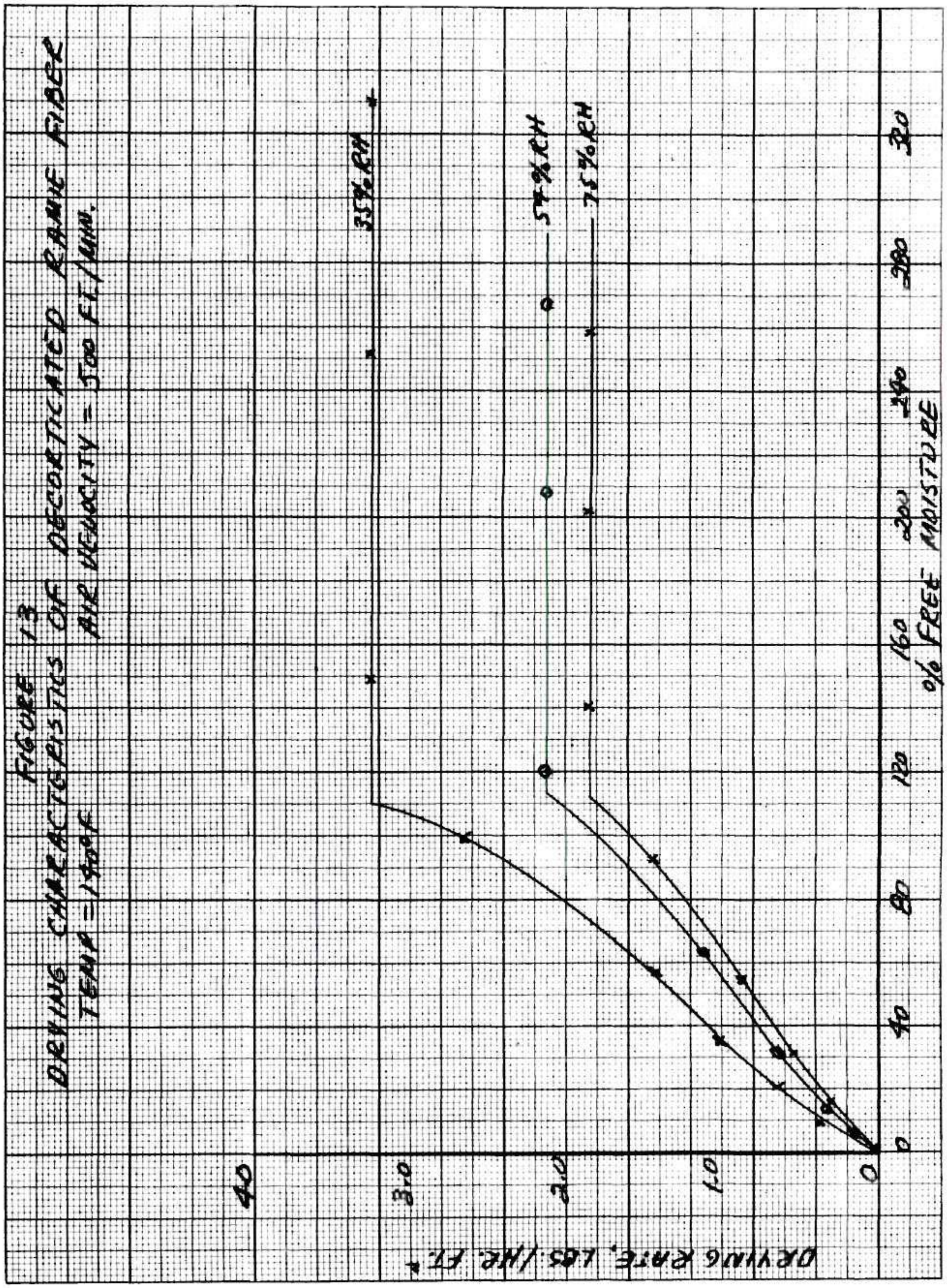


FIGURE 13
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER

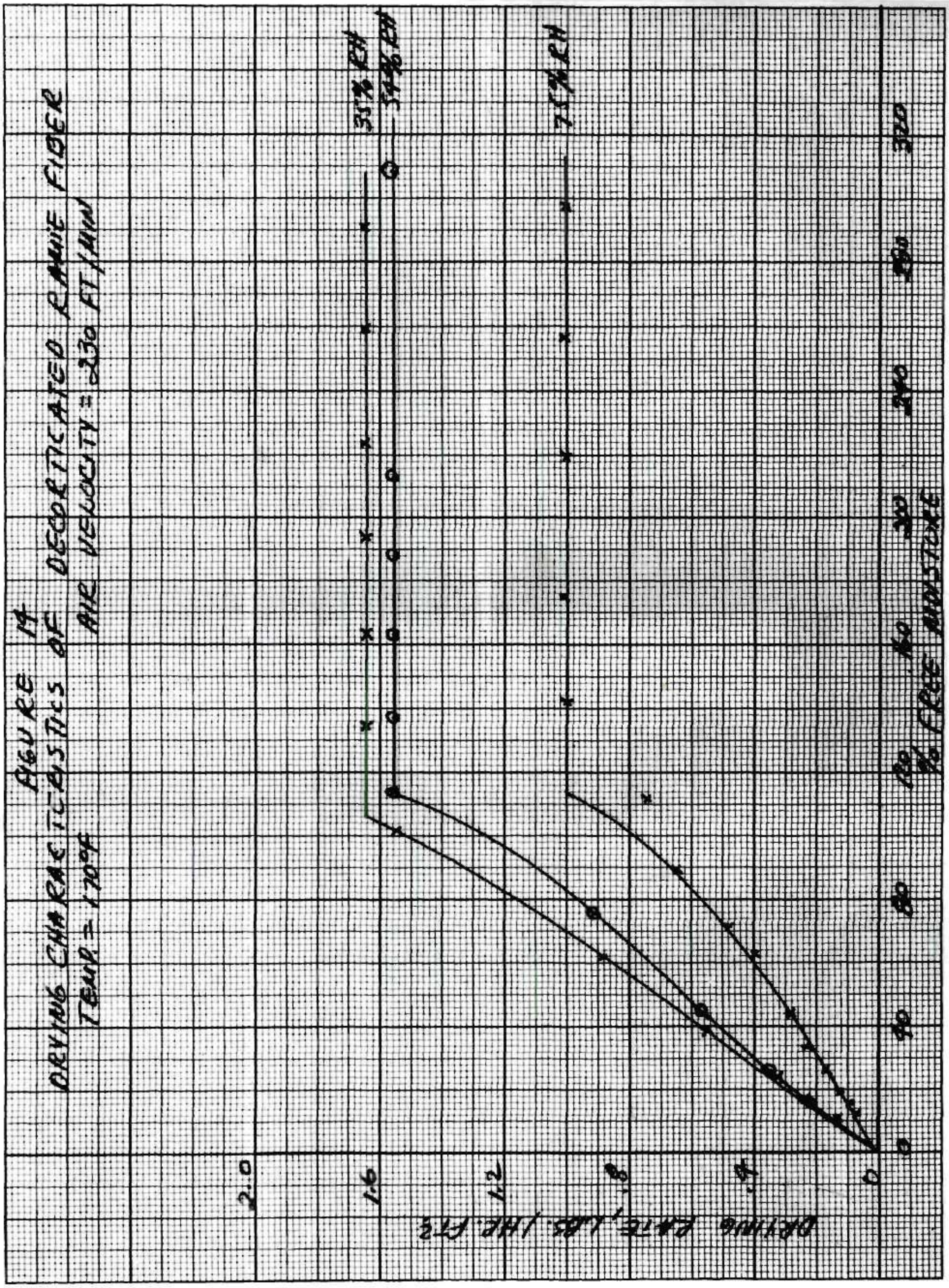


FIGURE 14
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER
TEMP = 170°F
AIR VELOCITY = 230 FT/MIN
35% RH
54% RH
71% RH
0
40
80
120
160
200
240
280
320
% FREE MOISTURE
0
.4
.8
1.2
1.6
2.0
DRYING RATE, LBS./HR. FT²

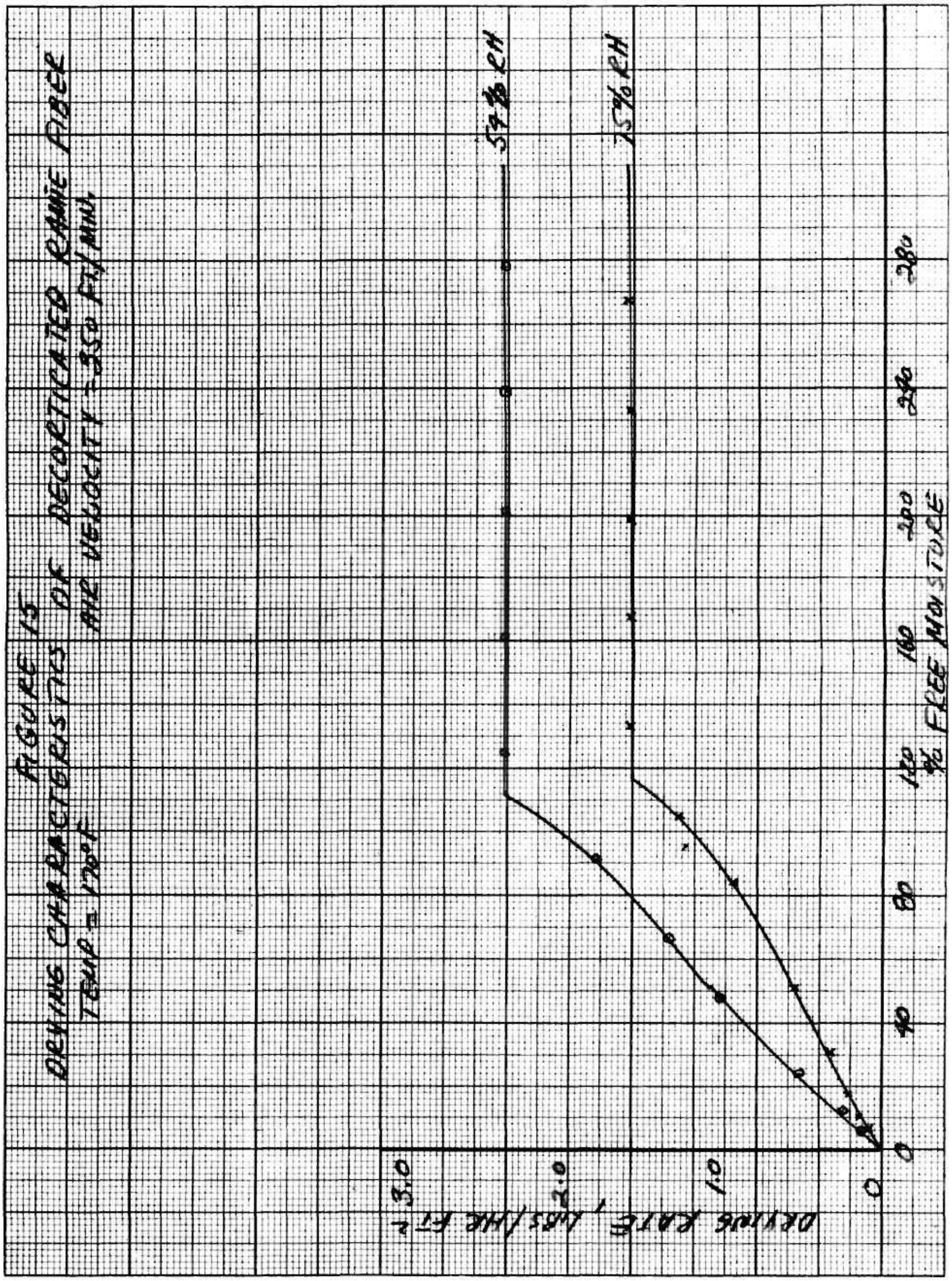


FIGURE 15
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER
TEMP = 170°F
AIR VELOCITY = 350 FT/MIN.
57% RH
75% RH
0
40
80
120
160
200
240
280
% FREE MOISTURE
0
1.0
2.0
3.0
DRYING RATE, LBS/HR FT²

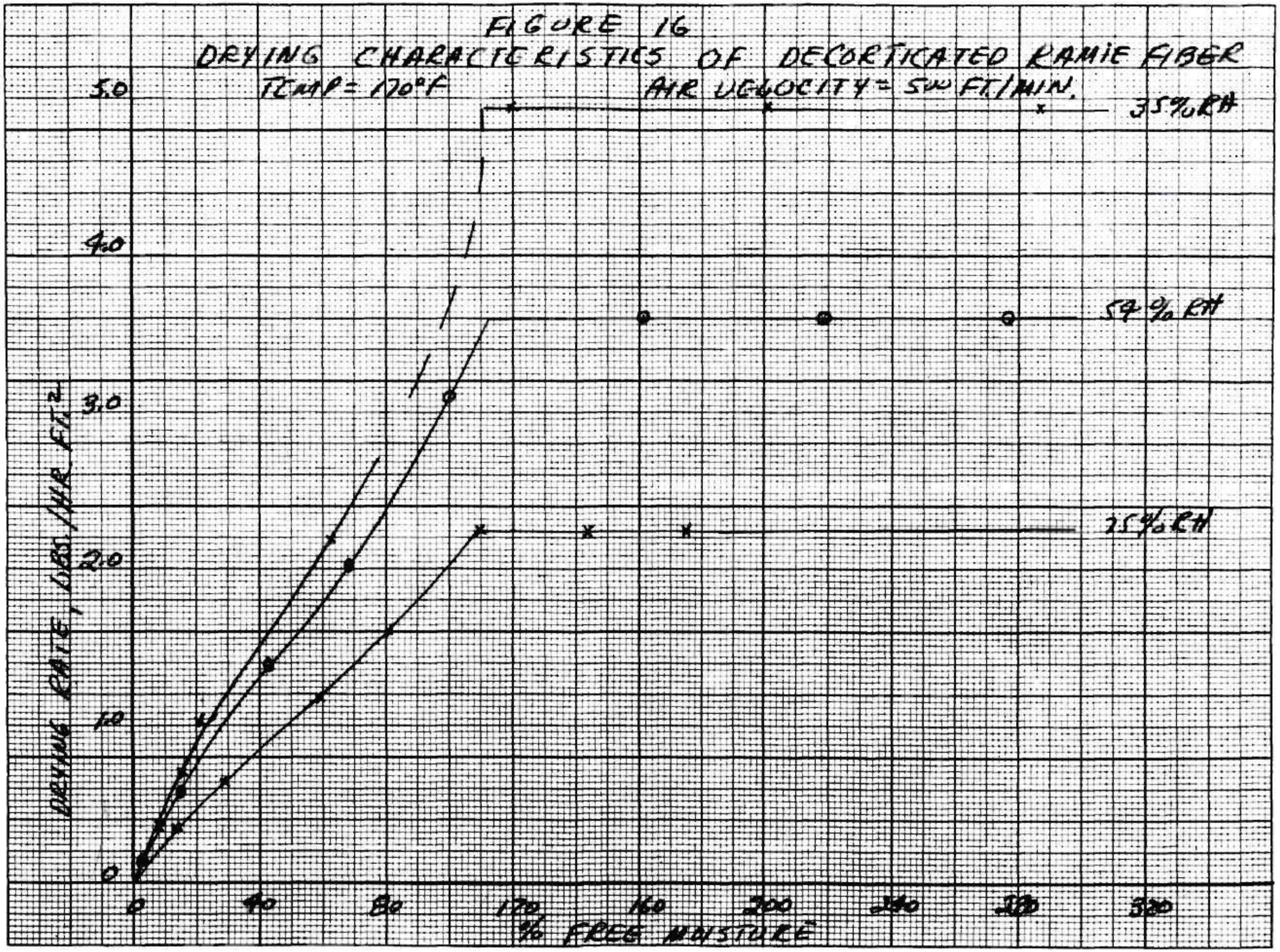


FIGURE 16
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER
TEMP = 170°F
AIR VELOCITY = 500 FT/MIN.
35% RH
54% RH
25% RH
DRYING RATE, LBS/HR FT.²
% FREE MOISTURE
5.0
4.0
3.0
2.0
1.0
0
0
40
80
160
200
320

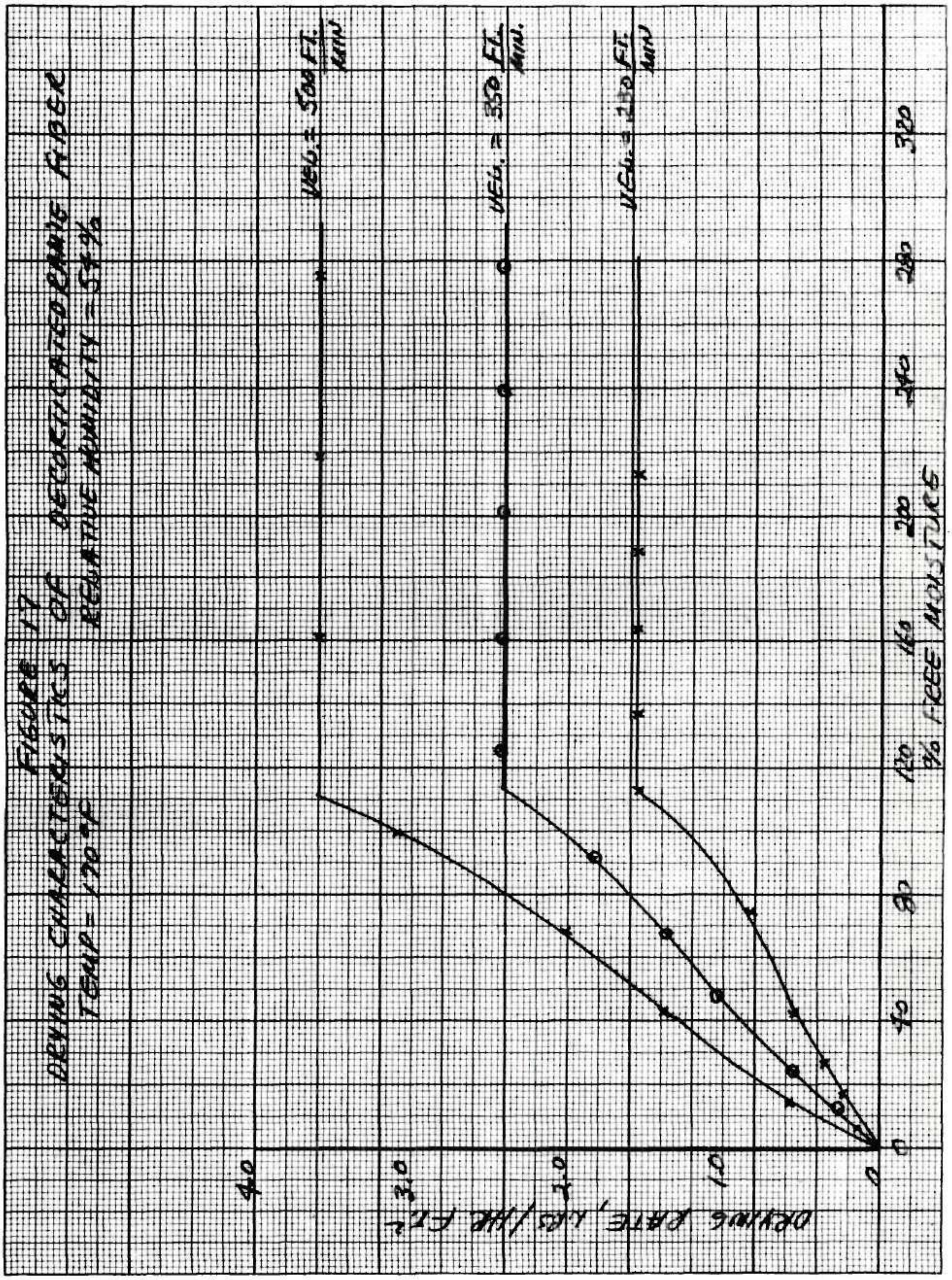


FIGURE 17
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER
TEMP = 170 °F
RELATIVE HUMIDITY = 54%
VEL. = 500 FT./MIN
VEL. = 350 FT./MIN
VEL. = FT./MIN
0
40
80
120
160
200
240
280
320
% FREE MOISTURE
0
1.0
2.0
3.0
4.0
DRYING RATE, LBS/HR FT.²

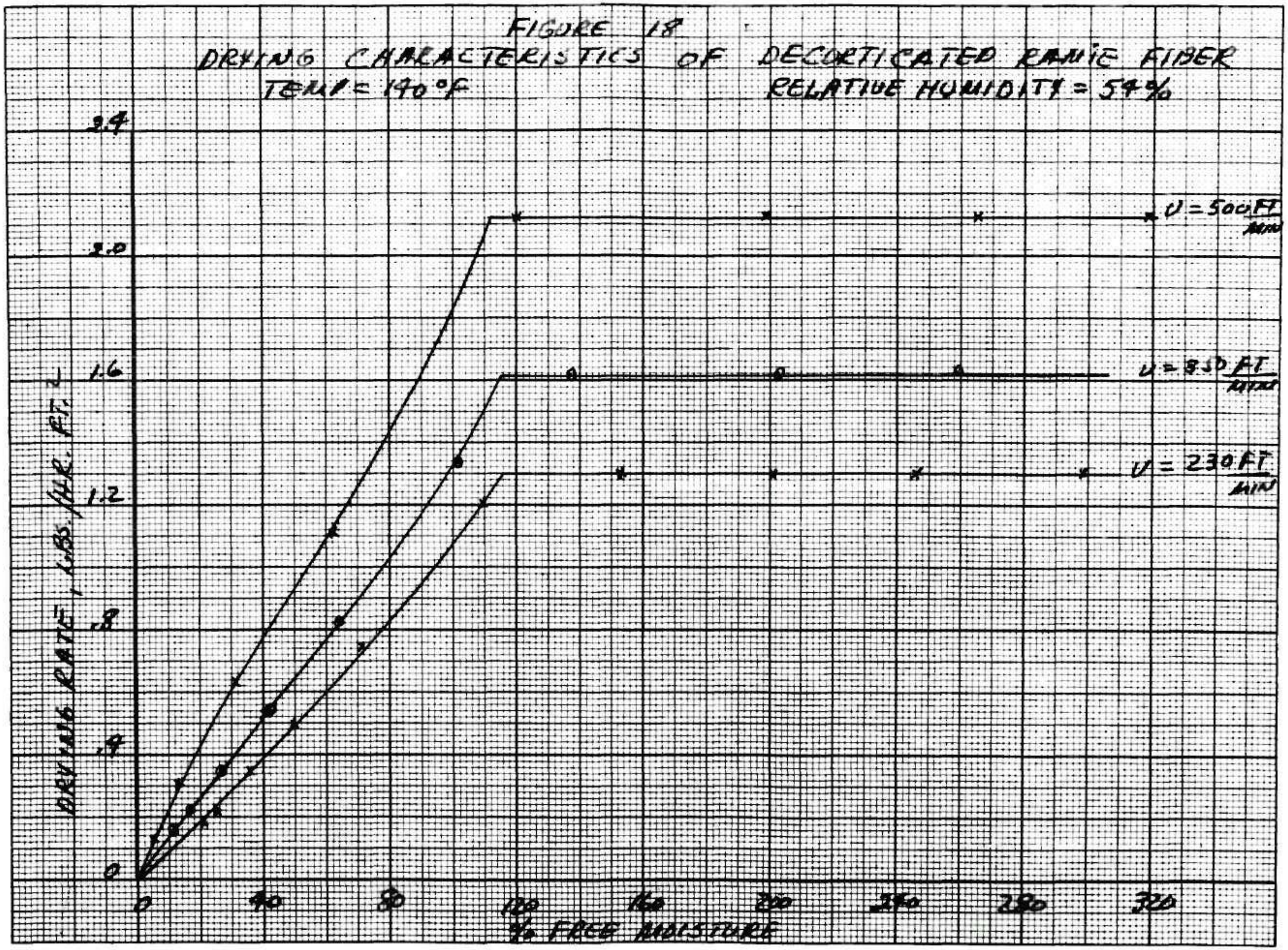


FIGURE 18
DRYING CHARACTERISTICS OF DECORTICATED RAMIE FIBER
TEMP = 140 °F
RELATIVE HUMIDITY = 54%
2.4
2.0
1.6
1.2
.8
.4
0
DRYING RATE, LBS./HR. FT.²
0
40
80
120
160
200
240
280
320
% FREE MOISTURE
U = 500 FT/MIN
U = 350 FT/MIN
U = 230 FT/MIN

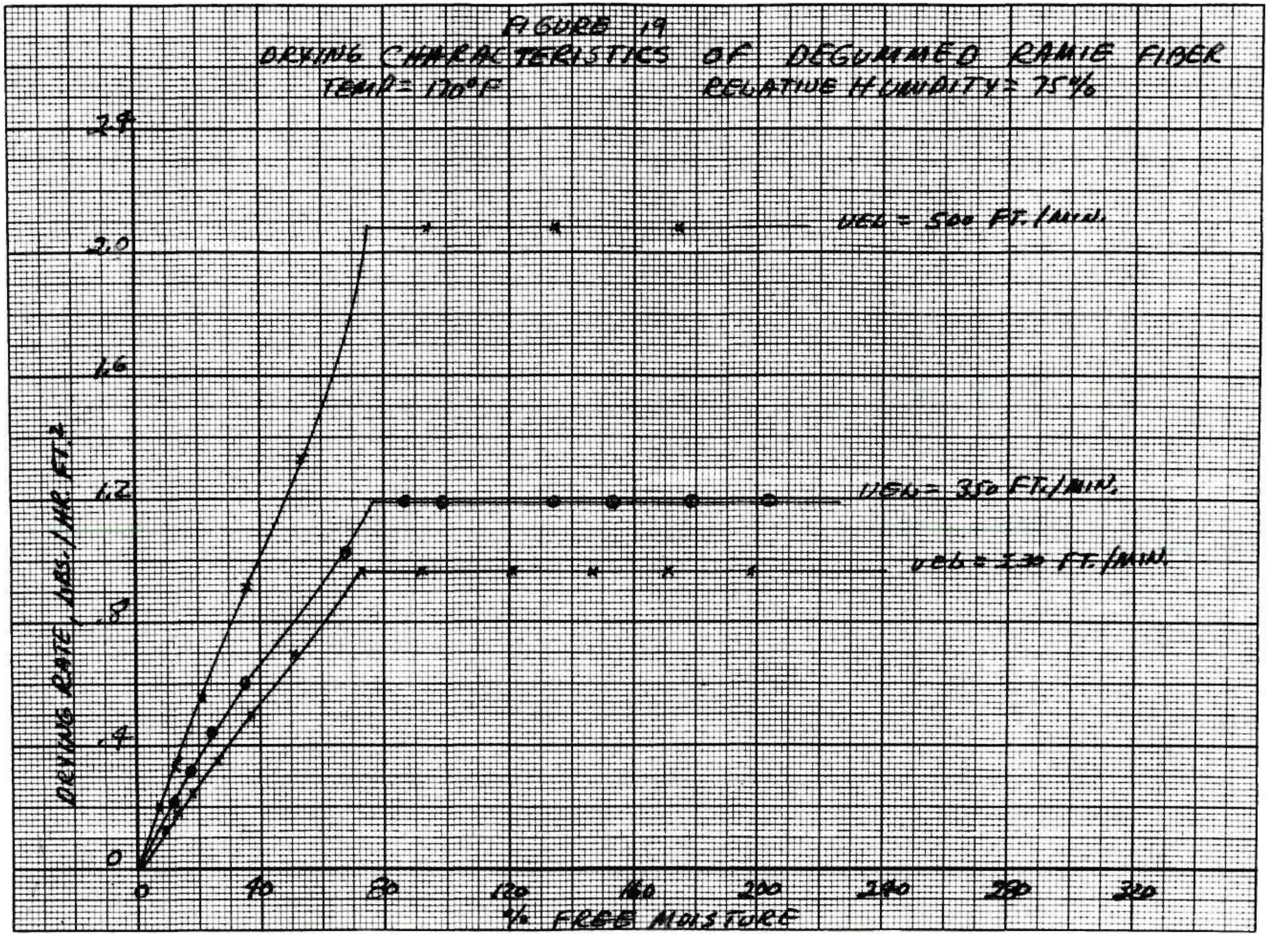


FIGURE 19
DRYING CHARACTERISTICS OF DEGUMMED RAMIE FIBER
TEMP = 170°F
RELATIVE HUMIDITY = 75%
VEL = 500 FT./MIN.
VEL = 350 FT./MIN.
DRYING RATE, LBS./HR. FT.²
% FREE MOISTURE
0
.4
.8
1.2
1.6
2.0
2.4
0
40
80
120
160
200
240
280
320

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APPENDIX

PREPARATION OF FIBERS

Professor J. L. Taylor, of the Textile Engineering Department, processed and supplied all the fibers studied.

The cotton studied was middling grade of one inch staple. It was in the physical state known as a card sliver. This means it had been processed through the picker and card which mechanically cleaned it and removed part of the short fibers. It analyzed to give an alpha cellulose content of 96.68%.

The decorticated ramie was Haitian ramie which had been decorticated and washed. It analyzed 90.65% alpha cellulose.

The degummed garnetted ramie was Floridian ramie that had been thoroughly degummed and washed. The samples were passed twice through the garnett card to open the fibers. This opened ramie analyzed 96.91% alpha cellulose.

The degummed, unopened ramie was Haitian ramie that had been degummed similarly to the opened ramie. It analyzed 96.70% alpha cellulose.

SAMPLE CALCULATIONS

Equilibrium moisture calculations for Sample 1, Run 9E is as follows:

Wet weight (sample and tare at equilibrium)	= 98.8635 gms.
Dry weight (sample and tare bone dry)	= 98.4092 gms.
Weight water present at equilibrium	= .4542 gms.

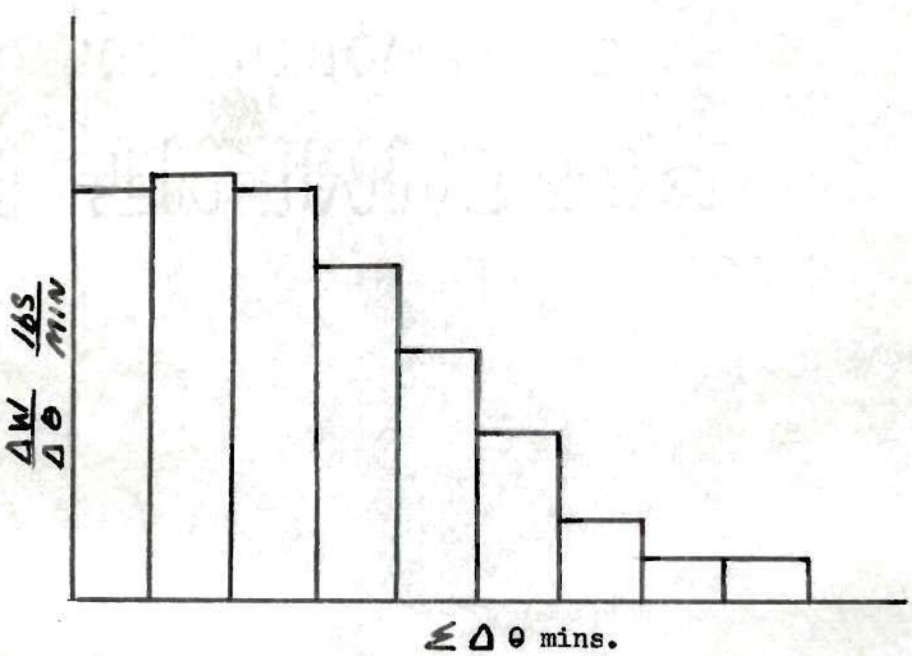
Dry weight	= 98.4092 gms.
Tare weight	= 94.4095 gms.
Bone dry fiber in sample	3.9997 gms.

Equilibrium moisture $= \frac{.4543 \text{ gms.}}{3.9997 \text{ gms.}}$

$= .1135$ gms./gm.

$= 11.35\%$ dry basis

The instantaneous drying rate of the fiber was arrived at as follows. From the weight-time data of the run values of $\Delta W/\Delta \Theta$ (lbs./min.) were tabulated. These values were plotted as the ordinate against $\Sigma \Delta \Theta$ as the abscissa. An example is given in Figure 20.



Plot of Incremental drying rates vs. time.

Figure 20.

It is evident that the area in each block is ΔW or in all blocks $\Sigma \Delta W$ or W, the weight of water removed. If $dW/d\Theta$ had been plotted against $\Sigma d\Theta$ or Θ the area under the curve would also be W. It follows, therefore, that if a smooth curve is drawn through the plot of $\Delta W/\Delta \Theta$ vs $\Sigma \Delta \Theta$ that at any time Θ the smooth curve represents the instantaneous rate $dW/d\Theta$. It is obvious that this is a method of approximation and is exact only in the limit as $\Delta \Theta$ goes to zero. For the purpose of analyzing this data the method is sufficient. An

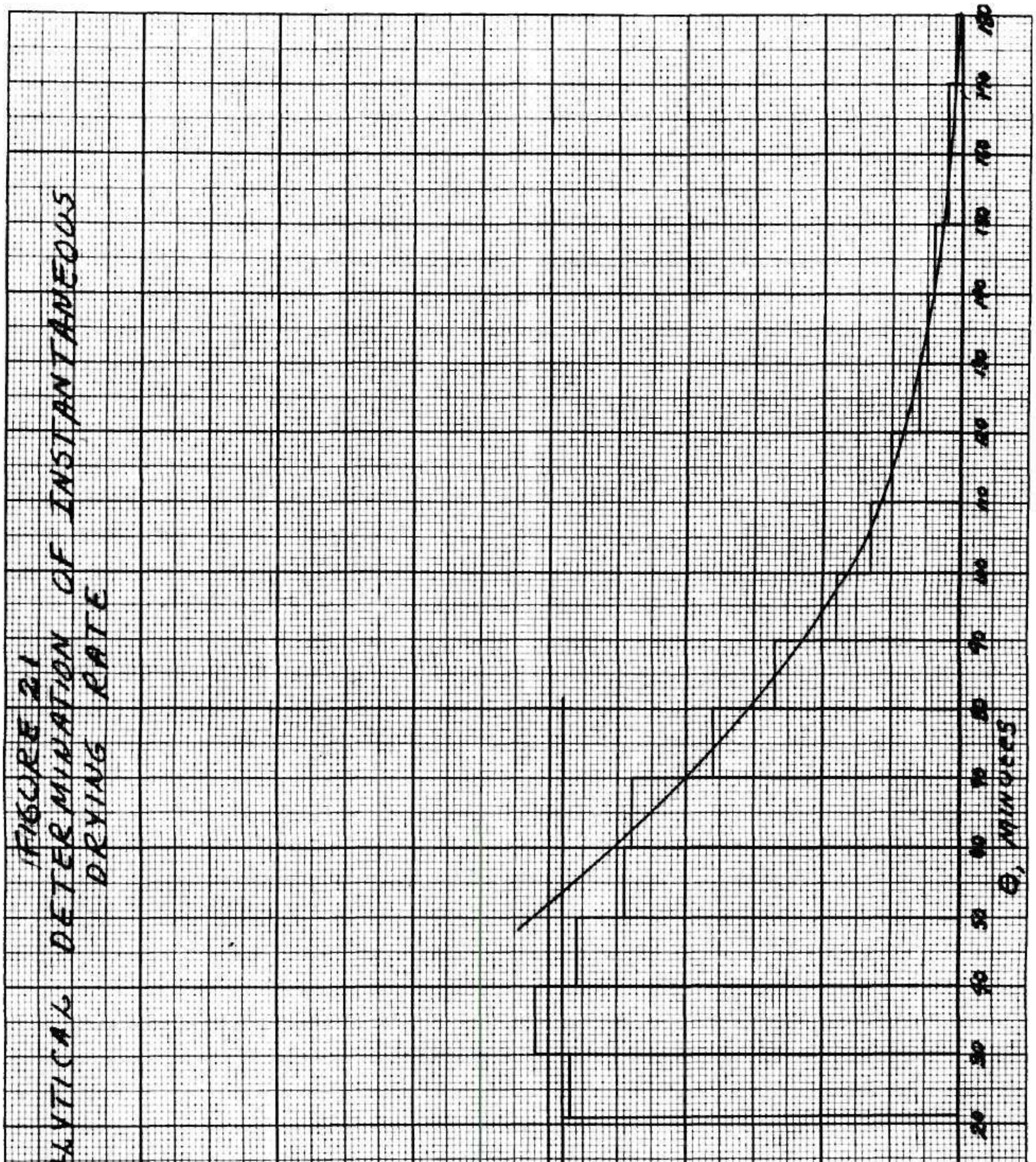


FIGURE 21
ANALYTICAL DETERMINATION OF INSTANTANEOUS
DRYING RATE
Θ, MINUTES
ΔW/ΔΘ, LBS/MIN
.00
.01
.02
.03
.04
.05
.06
.07
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180

illustration of this analysis is given in Figure 21.

To determine the free moisture content as a function of time it was assumed that when the drying sample had reached a constant total weight that equilibrium existed between the sample and the drying atmosphere. That this is not always true was shown by experiment. However, in spite of the error involved, the assumption is justifiable.

Knowing the final total weight of the sample and the percent equilibrium moisture for the drying conditions, it is possible to calculate the weight of the dry sample. The difference between the total weight at any instant and the weight of dry fiber represents the amount of water present. Then the ratio of the weight of water to the weight of dry fiber is the total moisture content. The free moisture is this value of total moisture less the value of the equilibrium moisture.

For Run 24D, shown in Figure 21, the final total weight equals 2.65 lbs. and the equilibrium moisture is 4.89%.

$$\text{Dry Fiber} = \frac{2.65}{1.0489} = 2.53 \text{ lbs.}$$

At forty minutes the total weight was 5.42 lbs. so the weight of water present was 2.89 lbs. The total moisture content at this time was 1.04 lbs./lb. or 104%. The free moisture equals 104 minus 4.89 equals 99.11%. This calculation was made for each recording of data.

Table I

Run 9E, Equilibrium Studies

T = 140° Tw = 135° F. RH = 87%

Sample*		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	98.8635	98.4092	94.4095	.1135
2	RRD	100.2140	99.4412	92.5008	.1113
3	DRD	96.7085	96.5101	93.9616	.0778
4	DRD	95.0300	94.7275	90.7180	.0756
5	CD	96.1221	96.0106	94.3729	.0682
6	CD	87.2899	87.1901	85.6908	.0667
7	GRD	103.4902	103.4657	102.9601	.0484
8	GRD	109.4629	103.4114	108.0540	.0380
9	RRW	99.6318	99.1700	95.3109	.1190
10	RRW	99.6394	99.1683	95.1533	.1173
11	DRW	89.1889	88.8722	85.2696	.0863
12	DRW	104.5171	104.1670	99.8104	.0803
13	CW	96.4167	96.2800	94.1202	.0633
14	CW	97.0414	96.8957	94.6537	.0649
15	GRW	101.0960	101.5006	99.3298	.0512
16	GRW	92.2175	92.1136	90.0113	.0495

* RRD - Decorticated ramie dry.
DRD - Degummed ramie dry.
CD - Cotton dry.
GRD - Garnetted ramie dry.
RRW - Decorticated ramie wet.
DRW - Degummed ramie wet.
CW - Cotton wet.
GRW - Garnetted ramie wet.

Table II

Run 10E, Equilibrium Studies

T = 140° F. Tw = 127° F. RH = 70%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	99.4060	99.0420	94.3710	.0779
2	RRD	97.8722	97.5061	92.5824	.0744
3	DRD	100.6780	100.3544	94.0683	.0515
4	DRD	100.9880	100.5052	90.7697	.0487
5	CD	95.2479	95.2120	94.3016	.0395
6	CD	87.2144	87.1602	85.8422	.0412
7	GRD	103.9210	103.8839	102.8795	.0370
8	GRD	109.1143	109.0695	108.0000	.0391
9	RRW	98.5711	98.3231	95.2254	.0803
10	RRW	99.5920	99.2370	94.0281	.0843
11	DRW	88.8100	88.6217	85.1215	.0538
12	DRW	102.4586	102.3181	99.7050	.0538
13	CW	95.6801	95.6147	94.0134	.0407
14	CW	96.1039	96.0306	94.4016	.0450
15	GRW	100.1797	100.1312	98.9920	.0426
16	GRW	90.6950	90.0550	89.7477	.0489

Table III

Run 11E, Equilibrium Studies

T = 140° F. Tw = 119° F. RH = 53%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	101.7017	101.3091	94.7580	.0582
2	RRD	99.4516	99.0868	92.6096	.0564
3	DRD	98.0600	97.9085	94.1360	.0402
4	DRD	92.7430	92.6610	90.6208	.0402
5	CD	95.6682	95.6204	94.3080	.0365
6	CD	87.0746	87.0205	85.6777	.0403
7	GRD	105.6052	105.5125	102.8640	.0345
8	GRD	109.2615	109.2211	108.1335	.0373
9	RRW	99.3104	99.0481	95.0884	.0664
10	RRW	99.5838	99.2690	94.3869	.0646
11	DRW	90.0422	89.8430	85.3478	.0444
12	DRW	103.0581	102.9230	99.8814	.0447
13	CW	95.6495	95.5815	93.8446	.0392
14	CW	96.1800	96.1150	94.5644	.0418
15	GRW	100.2640	100.2169	98.9663	.0376
16	GRW	91.1185	91.0699	89.7678	.0377

Table IV

Run 12E, Equilibrium Studies

T = 140° F. Tw = 112° F. RH = 41%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	101.7839	101.4864	94.5826	.0431
2	RRD	98.1588	97.9170	92.6590	.0458
3	DRD	100.6452	100.4574	94.1316	.0297
4	DRD	96.9932	96.8106	90.5925	.0294
5	CD	96.1794	96.1319	94.4980	.0291
6	CD	87.6473	87.5930	85.8785	.0317
7	GRD	103.8549	103.8239	102.8523	.0319
8	GRD	109.0740	109.0479	108.1040	.0277
9	RRW	103.6304	103.2364	95.2004	.0492
10	RRW	99.7700	99.5102	94.3206	.0502
11	DRW	91.3104	91.1088	85.2028	.0341
12	DRW	104.3191	104.1794	99.8760	.0325
13	CW	95.5583	95.5114	93.8646	.0285
14	CW	96.1780	96.1270	94.4041	.0296
15	GRW	99.6314	99.6120	98.9803	.0317
16	GRW	90.7235	90.6955	89.7592	.0299

Table V

Run 13E, Equilibrium Studies

T = 140° F. T_w = 107° F. RH = 34%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	104.6320	104.2773	94.6144	.0367
2	RRD	97.9220	97.7307	92.6231	.0379
3	DRD	98.8613	98.7413	93.9474	.0251
4	DRD	95.4143	95.3054	90.6720	.0236
5	CD	95.1849	95.1624	94.2440	.0245
6	CD	87.0420	87.0121	85.8596	.0267
7	GRD	103.5049	103.4865	102.8407	.0281
8	GRD	109.0574	109.0328	108.1375	.0275
9	RRW	100.6176	100.3865	95.0851	.0436
10	RRW	100.4236	100.1724	94.3665	.0432
11	DRW	93.4340	93.2144	85.2143	.0274
12	DRW	104.9541	104.8190	99.7605	.0268
13	CW	95.4930	95.4525	93.8552	.0255
14	CW	96.2571	96.2128	94.6413	.0271
15	GRW	100.7255	100.6700	98.9920	.0331
16	GRW	91.6836	91.6324	89.7573	.0273

Table VI

Run 14E, Equilibrium Studies

$T = 170^{\circ}$ F. $T_w = 165^{\circ}$ F. RH = 89%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	100.6615	100.1190	94.3785	.0944
2	RRD	98.1060	97.6746	92.7763	.0883
3	DRD	98.5850	98.3251	94.1623	.0622
4	DRD	95.7593	95.4830	90.7320	.0582
5	CD	95.6375	95.5852	94.4302	.0453
6	CD	86.4000	86.3643	85.5959	.0478
7	GRD	105.1403	105.0377	102.8602	.0472
8	GRD	110.0882	110.0105	108.1871	.0426
9	RRW	101.6120	101.0603	95.0574	.0920
10	RRW	101.9644	101.3257	94.6838	.0960
11	DRW	90.0465	89.7490	85.1874	.0652
12	DRW	104.1238	103.8652	99.8097	.0638
13	CW	96.9272	96.7983	94.0020	.0462
14	CW	96.3320	96.2680	94.5178	.0366
15	GRW	102.2384	102.1057	99.3604	.0481
16	GRW	91.5857	91.5074	89.7633	.0449

Table VII

Run 15E, Equilibrium Studies

T = 170° F. Tw = 155° F. RH = 69%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	99.7258	99.3977	94.3304	.0649
2	RRD	99.4038	98.9987	92.4767	.0622
3	DRD	102.4380	102.0940	93.9640	.0424
4	DRD	94.4389	94.2726	90.4704	.0438
5	CD	95.6215	95.5718	94.3576	.0409
6	CD	86.8328	86.7895	85.7208	.0406
7	GRD	105.0701	104.9960	102.9462	.0361
8	GRD	110.1902	110.1110	108.0585	.0386
9	RRW	102.4432	101.9700	95.0018	.0678
10	RRW	100.4060	100.0384	94.4295	.0655
11	DRW	89.5861	89.3957	85.2132	.0456
12	DRW	103.5680	103.3940	99.5785	.0456
13	CW	95.2747	95.2168	93.7888	.0406
14	CW	95.8546	95.7974	94.3949	.0407
15	GRW	101.9843	101.8880	99.1613	.0354
16	GRW	92.7232	92.6258	89.8545	.0352

Table VIII

Run 16E, Equilibrium Studies

$T = 170^\circ$ F. $T_w = 147.5^\circ$ F. RH = 56%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	100.4523	100.1131	94.3850	.0593
2	RRD	99.6067	99.2325	92.5263	.0559
3	DRD	98.4886	98.3272	93.9421	.0369
4	DRD	94.6904	94.5480	90.4720	.0350
5	CD	95.3545	95.3170	94.2365	.0348
6	CD	86.6425	86.6074	85.6553	.0368
7	GRD	104.4747	104.4280	102.8965	.0305
8	GRD	109.5950	109.5524	108.1320	.0300
9	RRW	101.6458	101.3070	95.2827	.0562
10	RRW	101.6537	101.2752	94.6698	.0573
11	DRW	91.9787	91.7258	85.2350	.0395
12	DRW	104.8020	104.5995	99.6110	.0405
13	CW	95.7866	95.7240	94.1096	.0387
14	CW	95.9591	95.9051	94.4720	.0367
15	GRW	100.5335	100.4800	98.8995	.0361
16	GRW	92.4951	92.4241	90.0920	.0305

Table IX

Run 17E, Equilibrium Studies

T = 170° F. Tw = 139° F. RH = 44%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	98.4770	98.3212	94.6583	.0426
2	RRD	98.1959	97.9656	92.5715	.0427
3	DRD	99.4745	99.3283	94.0453	.0277
4	DRD	94.5272	94.4337	90.4900	.0263
5	CD	95.9036	95.8634	94.2781	.0254
6	CD	87.0997	87.0660	85.6714	.0241
7	GRD	105.0235	104.9792	103.0742	.0233
8	GRD	109.9550	109.9226	108.2828	.0198
9	RRW	102.8116	102.4805	95.2359	.0457
10	RRW	99.9833	99.7610	94.5744	.0428
11	DRW	90.0700	89.9456	85.4739	.0278
12	DRW	105.8117	105.6405	99.8665	.0296
13	CW	95.5484	95.5115	93.9714	.0240
14	CW	96.2434	96.2074	94.5404	.0214
15	GRW	101.9568	101.9059	99.3304	.0197
16	GRW	92.3764	92.3277	89.8365	.0196

Table X

Run 18E, Equilibrium Studies

T = 170° F. Tw = 163° F. RH = 84%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	100.8494	100.3703	94.5504	.0822
2	RRD	101.9064	101.2300	92.6820	.0793
3	DRD	99.5835	99.2956	94.0410	.0547
4	DRD	94.6314	94.4188	90.5893	.0556
5	CD	96.0132	95.9403	94.4760	.0497
6	CD	87.0790	87.0100	85.7220	.0536
7	GRD	104.6040	104.5393	103.0657	.0439
8	GRD	109.5445	109.4905	108.1882	.0416
9	RRW	101.4699	100.9805	95.1093	.0842
10	RRW	101.6274	101.0650	94.4123	.0842
11	DRW	89.2225	88.9861	85.1337	.0614
12	DRW	102.9841	102.8095	99.7123	.0565
13	CW	95.3739	95.3045	93.8668	.0484
14	CW	96.0338	95.9565	94.3750	.0489
15	GRW	101.4394	101.3396	99.1194	.0450
16	GRW	92.2402	92.1250	89.8335	.0503

Table XI

Run 20E, Equilibrium Studies

$T = 200^{\circ}$ F. $T_w = 189^{\circ}$ F. RH = 79%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	103.1545	102.6266	94.7455	.0671
2	RRD	100.6000	100.1191	92.5550	.0637
3	DRD	101.1161	100.8323	94.0286	.0417
4	DRD	99.1769	98.8473	90.7039	.0405
5	CD	95.9937	95.9285	94.3054	.0402
6	CD	87.1977	87.1370	85.6584	.0411
7	GRD	105.7049	105.6310	103.0253	.0284
8	GRD	110.4704	110.3918	108.1337	.0349
9	RRW	100.9275	100.5770	95.0889	.0639
10	RRW	100.3153	99.9959	94.5580	.0600
11	DRW	90.7310	90.5082	85.3226	.0430
12	DRW	104.8337	104.6319	99.8776	.0422
13	CW	95.6952	95.6208	93.7445	.0397
14	CW	96.0210	95.9588	94.3915	.0397
15	GRW	101.0010	100.9297	98.9664	.0363
16	GRW	93.8792	93.7632	90.0400	.0312

Table XII

Run 21E, Equilibrium Studies

T = 200° F. Tw = 178° F. RH = 61%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	100.1360	99.8148	94.5166	.0607
2	RRD	96.5566	93.3405	92.4771	.0560
3	DRD	98.4900	98.3356	94.1920	.0374
4	DRD	98.7090	98.4145	90.7160	.0384
5	CD	95.7807	95.7376	94.2813	.0296
6	CD	86.9600	86.9289	85.7835	.0273
7	GRD	105.2250	105.1631	102.8010	.0262
8	GRD	110.3222	110.2702	108.1248	.0243
9	RRW	101.2821	100.9184	94.9590	.0610
10	RRW	100.0965	99.7818	94.3762	.0583
11	DRW	91.1260	90.8832	85.2584	.0432
12	DRW	105.4492	105.2261	99.5749	.0395
13	CW	95.7336	95.6847	93.8594	.0268
14	CW	95.9535	95.8950	94.2840	.0301
15	GRW	101.3935	101.3258	99.1060	.0305
16	GRW	92.6805	92.6010	89.9020	.0295

Table XIII

Run 22E, Equilibrium Studies

T = 200° F. Tw = 174° F. RH = 55%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	99.8551	99.6090	94.4697	.0480
2	RRD	98.3640	98.1230	92.6024	.0437
3	DRD	100.2040	100.0457	94.1572	.0269
4	DRD	94.4927	94.3814	90.5678	.0292
5	CD	95.4230	95.3930	94.2550	.0264
6	CD	86.7480	86.7206	85.6955	.0267
7	GRD	105.0450	105.0050	103.1082	.0211
8	GRD	110.0085	109.9680	108.1861	.0227
9	RRW	100.9420	100.6731	95.0920	.0472
10	RRW	100.4730	100.1915	94.3497	.0481
11	DRW	91.7025	91.5170	85.1233	.0290
12	DRW	104.7120	104.5684	99.5922	.0288
13	CW	95.7611	95.7314	94.0102	.0173
14	CW	95.8962	95.8694	94.4375	.0187
15	GRW	101.2630	101.2151	99.0429	.0221
16	GRW	92.1055	92.0546	89.8547	.0232

Table XIV

Run 23E, Equilibrium Studies

T = 200° F. Tw = 158° F. RH = 37%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	100.6844	100.5035	94.3612	.0295
2	RRD	99.0427	98.8618	92.4938	.0284
3	DRD	101.9333	101.7860	94.1309	.0193
4	DRD	95.8263	95.7325	90.6156	.0183
5	CD	95.4587	95.4360	94.3422	.0209
6	CD	86.7106	86.6961	85.7843	.0159
7	GRD	105.5113	105.4729	102.9007	.0150
8	GRD	110.9726	110.9381	108.2670	.0129
9	RRW	101.0072	100.8330	95.1825	.0308
10	RRW	98.7276	98.5974	94.3881	.0310
11	DRW	89.4336	89.3470	85.1781	.0208
12	DRW	103.0714	103.0014	99.5666	.0204
13	CW	95.4097	95.3839	93.8005	.0163
14	CW	95.8039	95.7830	94.4628	.0158
15	GRW	101.7337	101.7032	99.2840	.0126
16	GRW	92.9456	92.9063	89.8215	.0128

Table XV

Run 24E, Equilibrium Studies

T = 200° F. Tw = 196° F. RH = 92%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	100.5882	100.1017	94.5076	.0870
2	RRD	98.2960	97.8695	92.5913	.0810
3	DRD	98.4811	98.2347	93.9124	.0572
4	DRD	96.2053	Broken	-----	----
5	CD	104.1601	104.1032	102.8525	.0455
6	CD	109.1747	109.1290	108.2000	.0493
7	GRD	96.6964	96.6370	94.4997	.0278
8	GRD	86.7972	86.7543	85.6006	.0371
9	RRW	100.7031	100.2565	95.1792	.0880
10	RRW	100.6137	100.1293	94.4470	.0852
11	DRW	90.7488	90.4134	85.3460	.0664
12	DRW	106.1515	105.7524	99.7814	.0667
13	CW	95.5421	95.4703	93.8439	.0443
14	CW	95.8790	95.8214	94.3274	.0386
15	GRW	102.2790	102.1197	99.0855	.0525
16	GRW	92.6069	92.5050	90.1981	.0423

Table XVI

Run 26E, Equilibrium Studies

T = 200° F. Tw = 143° F. RH = 25%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	102.1659	102.0271	94.5850	.0187
2	RRD	99.5950	99.4630	92.6602	.0194
3	DRD	97.3446	97.3050	93.8791	.0115
4	DRD	96.4666	96.4184	91.9150	.0107
5	CD	95.9715	95.9561	94.2274	.0089
6	CD	87.2170	87.2050	85.6551	.0078
7	GRD	105.7549	105.7296	102.9760	.0092
8	GRD	110.8222	110.8056	108.2523	.0065
9	RRW	101.9050	101.7760	95.3558	.0201
10	RRW	100.4740	100.3638	94.6050	.0192
11	DRW	91.1975	91.1220	85.2221	.0128
12	DRW	104.4576	104.4015	99.6273	.0117
13	CW	95.3986	98.3848	93.8146	.0088
14	CW	96.0117	96.0025	94.3893	.0064
15	GRW	101.1120	101.0995	99.1550	.0057
16	GRW	92.0351	92.0172	89.7487	.0069

Table XVII

Run 27E, Equilibrium Studies

T = 140° F. Tw = 100° F. RH = 25%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	98.9140	98.7770	94.4788	.0319
2	RRD	98.8489	98.6585	92.7037	.0319
3	DRD	100.0476	99.9240	94.0698	.0211
4	DRD	98.6266	98.4900	92.0261	.0212
5	CD	95.3471	95.3231	94.1510	.0205
6	CD	87.1252	87.0935	85.7696	.0239
7	GRD	106.4360	106.3595	103.1851	.0241
8	GRD	110.5790	110.5300	108.3696	.0227
9	RRW	100.7971	100.6117	95.0298	.0331
10	RRW	100.0521	99.8776	94.4774	.0325
11	DRW	90.9260	90.7986	85.2508	.0230
12	DRW	105.5462	105.4162	99.5925	.0223
13	CW	96.5917	96.5426	93.8708	.0184
14	CW	95.8740	95.8379	94.3120	.0237
15	GRW	101.3844	101.3385	99.0644	.0202
16	GRW	92.2476	92.2051	90.0482	.01975

Table XVIII

Run 28E, Equilibrium Studies

T = 170° F. Tw = 113° F. RH = 17%

Sample		Wet Weight	Dry Weight	Tare Weight	Equilibrium Moisture
1	RRD	100.0802	99.9710	94.5935	.0222
2	RRD	99.1348	98.9950	92.6420	.0220
3	DRD	99.4181	99.3500	93.9984	.0127
4	DRD	96.3252	96.2694	91.9400	.0129
5	CD	95.9173	95.8937	94.2877	.0147
6	CD	87.1618	87.1455	85.7030	.0113
7	GRD	105.9513	105.9190	102.9964	.0111
8	GRD	110.9241	110.8935	108.2175	.0115
9	RRW	100.8369	100.6080	95.0210	.0410
10	RRW	99.4714	99.3570	94.4629	.0234
11	DRW	89.4366	89.3715	85.0974	.0153
12	DRW	102.7653	102.7205	99.6551	.0146
13	CW	95.7218	95.6988	93.9244	.0129
14	CW	96.0315	96.0103	94.3180	.0125
15	GRW	101.8719	101.8366	99.2222	.0134
16	GRW	92.8597	92.8262	89.9128	.0115

Table XIX

Run 1D, Decorticated Ramie

$T = 140^\circ$ F. $T_w = 130^\circ$ F. RH = 75%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture, % lb.H_2O/lb. fiber
0	5.70	.894	250
10	5.27	.894	223
20	4.79	.894	193
30	4.34	.894	164
40	3.92	.894	138
51	3.43	.874	108
60	3.12	.678	87.5
70	2.84	.538	69.8
80	2.60	.432	54.8
90	2.38	.337	40.9
100	2.24	.257	32.1
110	2.14	.206	25.8
120	2.04	.154	18.5
130	1.97	.113	15.1
140	1.93	.086	12.6
150	1.89	.066	10.1
160	1.85	.051	7.56
170	1.83	.041	6.30
180	1.81	.029	5.05
190	1.78	.021	3.15
200	1.76	.010	1.90
210	1.76	.006	1.90
220	1.75	.004	1.27
230	1.73	0	0
240	1.73	0	0

Table XX

Run 3D, Decorticated Ramie

$T = 140^\circ$ F. $T_w = 108^\circ$ F. RH = 35%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	6.50	1.42	344
10	5.87	1.42	300
20	5.17	1.42	253
30	4.48	1.42	205
40	3.76	1.42	155
50	3.09	1.38	109
60	2.48	.800	66.9
70	2.18	.576	46.1
80	1.95	.395	30.2
90	1.79	.257	19.2
100	1.68	.165	11.6
110	1.62	.103	7.4
120	1.57	.066	4.6
130	1.54	.041	1.9
140	1.52	.021	.5
150	1.51	0	0
160	1.51	0	0

Table XXI

Run 4D, Decorticated Ramie

$T = 140^{\circ}$ F. $T_w = 120^{\circ}$ F. RH = 54%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	5.99	1.30	347
10	5.36	1.30	299
20	4.69	1.30	248
30	4.07	1.30	201
40	3.43	1.30	154
50	2.84	1.20	111
60	2.37	.760	71.4
70	2.07	.500	50.4
80	1.88	.347	35.9
90	1.74	.241	24.4
100	1.64	.169	20.7
110	1.57	.123	12.4
120	1.53	.090	7.8
130	1.49	.062	6.3
140	1.46	.045	4.6
150	1.44	.031	2.5
160	1.43	.018	1.8
170	1.42	.008	1.0
180	1.41	0	0

Table XXII

Run 5D, Decorticated Ramie

$T = 140^\circ$ F. $T_w = 120^\circ$ F RH = 54%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	$dW/d\theta$ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	5.18	1.61	258
10	4.40	1.61	203
20	3.61	1.61	147
30	2.95	1.33	101
40	2.43	.822	64.4
50	2.10	.545	41.4
60	1.89	.350	26.5
70	1.75	.228	16.6
80	1.66	.158	10.3
90	1.60	.105	6.1
100	1.56	.068	3.3
110	1.54	.041	1.9
120	1.53	.021	1.2
130	1.51	0	0
140	1.51	0	0

Table XXIII

Run 6D, Decorticated Ramie

T = 140° F. Tw = 108° F. RH = 35%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	6.05	2.57	286
10	4.69	2.57	200
20	3.40	2.57	118
30	2.48	1.00	55.7
40	2.04	.576	27.3
50	1.83	.313	13.7
60	1.72	.181	6.7
70	1.66	.103	2.8
80	1.64	.045	1.5
90	1.63	.021	.9
100	1.62	0	0
110	1.62	0	0

Table XXIV

Run 7D, Decorticated Ramie

T = 140° F. Tw = 130° F. RH = 75%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, % lbs. H_2Ox100/lb. fiber
0	4.51	1.11	301
5	4.24	1.11	277
15	3.70	1.11	228
25	3.10	1.11	171
35	2.60	1.11	147
45	2.17	.766	88.8
55	1.87	.544	61.2
65	1.62	.370	38.6
75	1.47	.236	24.9
85	1.37	.150	15.8
95	1.30	.097	9.4
105	1.26	.062	5.8
115	1.24	.037	3.8
125	1.22	.021	2.1
135	1.21	.006	1.2
145	1.20	0	0
155	1.20	0	0

Table XXV

Run 8D, Decorticated Ramie

$T = 140^{\circ}$ F. $T_w = 130^{\circ}$ F. RH = 75%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	$dW/d\theta$ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	5.48	1.84	259
10	4.61	1.84	202
20	3.70	1.84	140
30	2.99	1.44	92.2
40	2.45	.888	55.6
50	2.09	.546	31.5
60	1.86	.309	16.0
70	1.77	.165	10.0
80	1.71	.103	6.0
90	1.66	.058	2.6
100	1.64	.031	1.3
110	1.63	.013	.6
126	1.62	0	0
136	1.62	0	0

Table XXVI

Run 9D, Decorticated Ramie

$T = 140^{\circ}$ F. $T_w = 120^{\circ}$ F. RH = 54%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	$dW/d\theta$ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	5.08	2.12	320
6	4.45	2.12	267
13	3.74	2.12	208
23	2.70	2.12	120
33	2.02	1.11	63.1
43	1.63	.640	31.3
53	1.42	.308	12.7
63	1.34	.119	6.0
73	1.30	.043	2.7
83	1.28	.010	.9
93	1.27	0	0
103	1.27	0	0

Table XXVII

Run 10D, Decorticated Ramie

$T = 140^\circ$ F. $T_w = 108^\circ$ F. RH = 35%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, % lbs. H_2Ox100/lb. fiber
0	5.70	3.24	330
7	4.60	3.24	251
15	3.33	3.24	150
20	2.68	2.64	100
25	2.12	1.42	56.3
30	1.83	1.01	35.4
35	1.64	.658	20.9
40	1.49	.391	9.4
50	1.40	.123	2.6
60	1.38	.041	1.1
70	1.37	0	0
80	1.37	0	0

Table XXVIII

Run 11D, Degummed Ramie

$T = 140^\circ$ F. $T_w = 130^\circ$ F. RH = 75%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	6.91	.988	208
10	6.46	.988	188
20	6.00	.988	167
30	5.52	.988	145
40	5.01	.988	122
50	4.53	.988	100
60	4.05	.988	78.4
70	3.63	.791	59.2
80	3.26	.611	42.4
90	2.99	.458	30.0
100	2.81	.327	21.8
110	2.68	.224	14.9
120	2.59	.156	11.8
130	2.51	.123	8.2
140	2.45	.103	5.5
150	2.39	.090	2.6
160	2.35	.070	.9
170	2.33	.041	.1
180	2.32	0	0
190	2.32	0	0

Table XXIX

Run 12D, Degummed Ramie

T = 140° F. Tw = 120° F. RH = 54%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	7.39	1.28	236
10	6.80	1.28	209
20.5	6.15	1.28	179
30.0	5.56	1.28	152
40	4.90	1.28	127
50	4.29	1.28	93.3
60	3.72	1.04	67.0
70	3.25	.772	45.3
80	2.93	.536	30.5
90	2.72	.378	20.8
100	2.56	.257	13.5
110	2.45	.164	8.4
120	2.40	.103	6.1
130	2.34	.062	3.3
140	2.32	.041	2.4
150	2.30	.023	1.5
160	2.78	.001	.6
170	2.27	0	0
180	2.27	0	0

Table XXX

Run 14D, Degummed Ramie

T = 140° F. Tw = 108° F. RH = 35%

Air velocity = 350 ft./min.

Time	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	7.32	1.93	225
10	6.40	1.93	184
20	5.48	1.93	143
30	4.48	1.93	98.2
40	3.64	1.51	60.4
50	3.02	.730	32.6
60	2.74	.452	20.0
70	2.54	.288	11.1
80	2.44	.196	6.6
90	2.36	.172	3.0
100	2.33	.055	2.7
110	2.30	.021	.3
120	2.29	0	0
130	2.29	0	0

Table XXXI

Run 15D, Degummed Ramie

T = 140° F. Tw = 120° F. RH = 54%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	6.65	1.67	216
10	5.81	1.67	173
20	5.01	1.67	137
30	4.20	1.67	97.5
40	3.51	1.15	64.5
50	3.04	.761	41.7
60	2.73	.522	26.7
70	2.53	.329	17.1
80	2.40	.206	10.9
90	2.34	.123	8.0
100	2.30	.093	6.1
110	2.27	.072	4.7
120	2.24	.058	3.2
130	2.21	.041	1.7
140	2.19	.026	1.0
150	2.19	.021	1.0
160	2.18	.016	.3
180	2.17	0	0
200	2.17	0	0
210	2.17	0	0

Table XXXII

Run 16D, Degummed Ramie

$T = 140^\circ$ F. $T_w = 130^\circ$ F. RH = 75%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	$dW/d\theta$ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	6.82	1.19	226
10.5	6.18	1.19	195
20	5.63	1.19	168
30	5.10	1.19	143
40	4.52	1.19	112
50	3.96	1.19	87.1
60	3.40	.968	59.9
70	3.01	.683	40.8
80	2.73	.463	27.2
90	2.54	.309	18.0
100	2.41	.200	11.6
110	2.32	.134	7.2
120	2.27	.093	4.8
130	2.23	.064	2.9
140	2.22	.043	2.4
162	2.19	.013	.9
187	2.17	0	0
195	2.17	0	0

Table XXXIII

Run 18D, Degummed Ramie

$T = 140^\circ$ F. $T_w = 108^\circ$ F. RH = 35%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb.fiber
0	7.29	3.39	246
5	6.57	3.39	212
11	5.57	3.39	164
14.75	4.97	3.39	136
20	4.11	3.39	94.2
25	3.50	2.50	62.8
30	2.81	1.10	31.2
40	2.34	.510	11.6
50	2.20	.148	2.5
60	2.17	.027	1.0
70	2.15	0	0
80	2.15	0	0

Table XXXIV

Run 19D, Degummed Ramie

T = 140° F. Tw = 120° F. RH = 54%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	7.34	3.19	193
6	6.37	3.19	154
15	4.97	3.19	107
20	4.40	2.13	66
25	3.80	1.37	49.3
35	3.16	.678	23.4
45	2.84	.370	10.5
55	2.69	.196	4.4
66	2.64	.103	2.4
75	2.61	.045	1.2
85	2.59	.016	.2
95	2.58	0	0
105	2.58	0	0

Table XXXV

Run 20D, Degummed Ramie

$T = 140^{o}$ F. $T_w = 130^{o}$ F. RH = 75%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	6.34	1.98	175
8	5.57	1.98	141
16	4.80	1.98	106
24	4.05	1.65	73.4
34	3.23	.926	36.9
44	2.80	.524	18.0
54	2.60	.288	9.1
64	2.50	.165	4.7
74	2.45	.086	2.5
84	2.42	.041	1.2
94	2.40	.016	.3
104	2.39	0	0
114	2.39	0	0

Table XXXVI

Run 21D, Degummed Ramie

$T = 170^\circ$ F. $T_w = 132^\circ$ F. RH = 35%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	6.51	1.85	193
10	5.62	1.85	152
20	4.72	1.85	112
30	3.81	1.79	71
40	3.10	.966	33.5
50	2.68	.590	19.0
60	2.49	.330	10.4
70	2.38	.181	5.4
80	2.32	.097	2.7
90	2.28	.045	.9
100	2.27	.021	.4
110	2.26	0	0
120	2.26	0	0

Table XXXVII

Run 22D, Degummed Ramie

$T = 170^\circ$ F. $T_w = 146^\circ$ F. RH = 54%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	$dW/d\Theta$ lb./hr.ft.^{2}	Free Moisture,% lbs. H_2Ox100/lb. fiber
0	8.24	1.30	201
10	7.60	1.30	177
20	6.97	1.30	154
30	6.34	1.30	131
40	5.68	1.30	106
50	5.05	1.30	83.1
60	4.45	1.09	60.9
70	3.96	.832	43.7
80	3.62	.596	28.5
90	3.37	.422	19.8
100	3.22	.308	14.5
110	3.07	.206	9.2
120	2.98	.143	6.0
130	2.93	.103	4.2
140	2.88	.066	2.5
150	2.85	.043	1.4
160	2.84	.027	1.0
170	2.82	.016	.3
180	2.80	0	0
190	2.80	0	0

Table XXXVIII

Run 24D, Degummed Ramie

$T = 170^\circ$ F. $T_w = 158^\circ$ F. RH = 75%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, % lbs. H_2Ox100/lb. fiber
0	7.81	1.19	203
10	7.20	1.19	179
21.3	6.54	1.19	153
30	6.04	1.19	134
40	5.42	1.19	99
50	4.86	1.19	87.1
60	4.37	1.02	67.9
70	3.89	.802	56.7
80	3.53	.606	34.6
90	3.26	.444	23.9
100	3.08	.313	16.8
110	2.95	.216	11.7
120	2.85	.146	7.7
130	2.79	.103	5.4
140	2.74	.064	3.4
150	2.70	.041	1.8
160	2.68	.021	1.0
170	2.66	.006	.3
180	2.65	0	0
190	2.65	0	0

Table XXXIX

Run 25D, Degummed Ramie

T = 170° F. Tw = 158° F. RH = 75%

Air velocity = 230 ft./min

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, % lbs. H_2Ox100 lb. fiber
0	5.70	.966	198
10	5.21	.966	172
20	4.73	.966	121
40	3.79	.966	91.6
50	3.33	.966	72.2
60	2.94	.698	51.6
70	2.67	.493	37.1
80	2.46	.345	25.9
90	2.32	.247	18.5
100	2.22	.177	13.2
110	2.14	.126	8.9
120	2.10	.091	6.8
130	2.05	.061	4.2
140	2.03	.041	3.1
160	1.98	.016	.4
180	1.97	0	0
190	1.97	0	0

Table XL

Run 26D, Degummed Ramie

T = 170° F. Tw = 146° F. RH = 54%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	6.50	1.73	265
10	5.70	1.73	220
20	4.77	1.73	167
30	3.93	1.73	119
40	3.13	1.73	74.0
50	2.51	.765	38.7
60	2.24	.494	25.7
70	2.06	.267	13.1
80	1.96	.164	7.5
90	1.90	.092	4.08
101	1.85	.041	1.3
110	1.83	0	0
120	1.83	0	0

Table XLI

Run 27D, Degummed Ramie

T = 170° F. Tw = 132° F. RH = 35%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	7.47	3.35	214
8	6.18	3.35	155
16	4.86	3.35	104
24	3.76	1.93	57.2
32	3.10	.905	33.3
40	2.77	.473	15.1
50	2.58	.233	7.0
60	2.50	.134	3.6
70	2.48	.066	2.8
80	2.44	.029	1.1
90	2.43	.008	.7
100	2.42	0	0
110	2.42	0	0
120	2.42	0	0

Table XLII

Run 28D, Degummed Ramie

$T = 170^\circ$ F. $T_w = 132^\circ$ F. RH = 35%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	$dW/d\theta$ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	7.92	3.62	211
5	7.04	3.62	176
10	6.16	3.62	141
15	5.27	3.62	106
20	4.51	3.62	75.9
25	3.92	1.95	52.6
30	3.50	1.35	36.0
35	3.23	.894	25.3
45	2.89	.432	11.9
55	2.73	.216	5.6
65	2.66	.107	2.96
75	2.62	.045	1.27
85	2.60	.012	.49
95	2.59	0	0
105	2.59	0	0
115	2.59	0	0

Table XLIII

Run 29D, Degummed Ramie

T = 170° F. Tw = 146° F. RH = 54%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	6.05	2.55	188
5	5.42	2.55	158
10	4.81	2.55	129
15	4.19	2.55	97
25	3.24	1.68	52.8
35	2.61	.658	22.2
45	2.35	.292	9.7
54	2.25	.165	4.85
65	2.70	.066	2.42
78	2.16	.041	.49
84	2.15	0	0
95	2.15	0	0

Table XLIV

Run 30D, Degummed Ramie

$T = 170^\circ$ F. $T_w = 158^\circ$ F. RH = 75%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	$dW/d\theta$ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	7.06	2.08	175
10	6.04	2.08	135
20	5.03	2.08	94.6
30	4.00	1.33	53.9
40	3.55	.912	36.0
50	3.18	.555	21.3
60	2.97	.346	13.0
70	2.83	.206	7.4
80	2.77	.123	5.04
90	2.71	.068	3.66
100	2.68	.041	1.46
110	2.67	.019	1.07
125	2.65	.004	0.27
132	2.64	0	0
140	2.64	0	0

Table XLV

Run 31D, Decorticated Ramie

T = 170° F. Tw = 158° F. RH = 75%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	4.70	2.24	175
5	4.15	2.24	142
10	3.61	2.24	110
15	3.14	1.60	81.0
20	2.77	1.18	58.7
30	2.27	.658	28.7
41	2.01	.349	13.1
50	1.89	.167	5.85
60	1.84	.076	2.87
70	1.81	.016	1.07
80	1.79	0	0
90	1.79	0	0

Table XLVI

Run 32D, Decorticated Ramie

T = 170° F. Tw = 146° F. RH = 54%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	5.78	3.60	276
5	4.92	3.60	219
10	4.03	3.60	161
15	3.26	3.09	100
20	2.64	2.01	68.5
25	2.25	1.38	42.8
35	1.82	.575	14.4
45	1.61	.123	0.58
55	1.60	0	0
65	1.60	0	0

Table XLVII

Run 33D, Decorticated Ramie

T = 170° F. Tw = 132° F. RH = 35%

Air velocity = 500 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	5.62	4.94	287
5	4.38	4.94	201
10	3.22	4.94	120
15	2.40	2.18	63.1
20	1.95	1.03	31.9
25	1.73	.617	16.6
30	1.62	.350	9.0
35	1.56	.206	4.8
40	1.51	.093	1.4
45	1.50	.021	.7
50	1.49	0	0
55	1.49	0	0

Table XLVIII

Run 35D, Decorticated Ramie

$T = 170^{o}$ F. $T_w = 146^{o}$ F. RH = 54%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture. lbs. H_2Ox100/lb. fiber
0	5.93	2.43	278
5	5.33	2.43	239
10	4.74	2.43	201
15	4.12	2.43	161
20	3.56	2.43	125
25	3.05	1.83	91.3
30	2.67	1.38	66.9
35	2.38	1.03	48.2
45	2.01	.534	24.3
55	1.82	.247	12.0
65	1.72	.117	5.6
75	1.68	.045	3.0
85	1.65	.025	.90
95	1.64	.016	.47
105	1.63	0	0
115	1.63	0	0

Table XLIX

Run 37D, Decorticated Ramie

T = 170° F. Tw = 158° F. RH = 75%

Air velocity = 350 ft./min.

Time Mins.	Total Weight lbs.	dW/dθ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	5.53	1.61	375
5	5.10	1.61	338
10	4.69	1.61	302
15	4.29	1.61	267
20	3.90	1.61	233
25	3.51	1.61	199
30	3.13	1.61	167
35	2.77	1.61	134
40	2.44	1.30	106
45	2.20	.945	84.2
55	1.82	.555	51.0
65	1.59	.339	31.0
75	1.44	.216	17.9
85	1.35	.145	10.0
95	1.31	.086	6.6
105	1.28	.058	3.9
115	1.26	.025	2.2
125	1.24	.006	.5
135	1.23	0	0
145	1.23	0	0

Table L

Run 36D, Decorticated Ramie

T = 170°F. Tw = 146° F. RH = 54%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	5.24	1.56	308
5	4.80	1.56	213
10	4.42	1.56	188
15	4.04	1.56	163
20	3.65	1.56	137
25	3.30	1.42	113
35	2.72	.906	74.8
45	2.23	.576	42.3
55	1.99	.350	26.4
65	1.83	.212	15.8
75	1.74	.148	9.9
85	1.68	.078	5.9
95	1.64	.039	3.2
105	1.62	.011	1.95
115	1.59	0	0
125	1.59	0	0

Table LI

Run 38D, Decorticated Ramie

T = 170° F. Tw = 158° F. RH = 75%

Air velocity = 230 ft./min.

Time Mins.	Table Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	5.70	1.01	336
10	5.20	1.01	297
20	4.69	1.01	257
30	4.21	1.01	220
40	3.67	1.01	177
50	3.20	1.01	142
60	2.84	.740	114
70	2.54	.616	90.0
80	2.30	.483	71.2
90	2.10	.359	63.4
100	1.95	.287	43.9
110	1.82	.218	33.8
120	1.72	.170	26.0
130	1.64	.127	19.8
140	1.59	.095	15.9
150	1.54	.074	12.1
160	1.51	.055	9.7
170	1.48	.041	7.4
180	1.46	.033	5.8
190	1.44	..029	4.3
210	1.41	.018	2.0
230	1.38	0	0
240	1.38	0	0

Table LII

Run 39D, Decorticated Ramie

T = 170° F. Tw = 132° F. RH = 35%

Air velocity = 230 ft./min.

Time Mins.	Total Weight lbs.	dW/dΘ lb./hr.ft.^{2}	Free Moisture, lbs. H_2Ox100/lb. fiber
0	4.93	1.65	291
5	4.53	1.65	259
10	4.10	1.65	224
15	3.72	1.65	194
20	3.33	1.65	163
25	2.98	1.65	135
30	2.62	1.56	102
40	2.07	.885	62.3
50	1.79	.555	39.8
60	1.61	.329	25.4
70	1.50	.226	16.6
80	1.42	.123	10.2
90	1.37	.062	6.10
100	1.34	.041	3.70
110	1.32	.023	2.10
120	1.30	.006	.50
130	1.29	0	0
140	1.29	0	0